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OPTOELECTRONICS DATA BOOK

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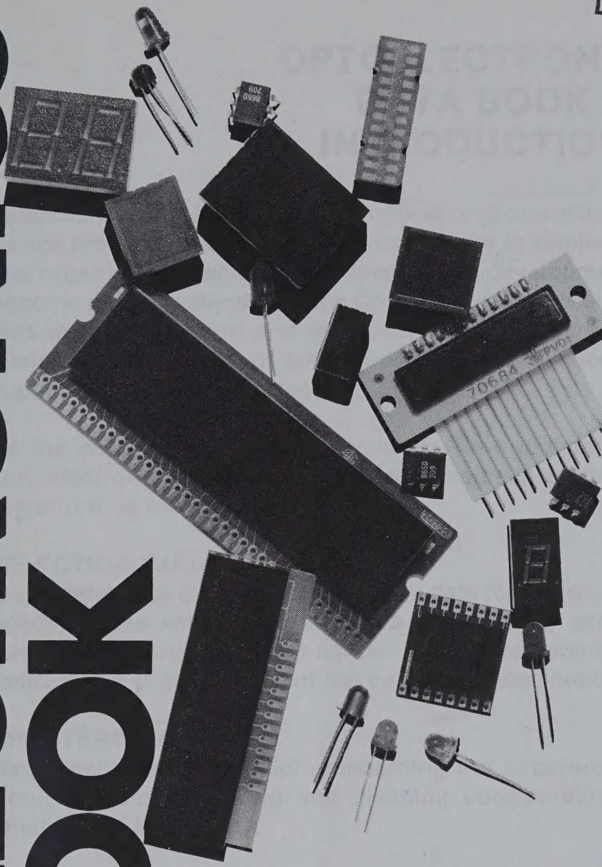

FAIRCHILD

464 Ellis Street, Mountain View, California 94042

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OPTOELECTRONICS DATA BOOK INTRODUCTION

Fairchild Camera & Instrument Corporation is one of the world's largest semiconductor device producers, and is a recognized leader in semiconductor technology. As part of this organization, which has pioneered the development of many products that have become industry standards, the Optoelectronics Division benefits from broad capabilities in device design and manufacture. These benefits are passed on to you, the customer, in the form of advanced design, excellence of performance, continuity of supply, and cost-effectiveness.

As the customer, you and your needs have dictated the form and content of this Optoelectronic Data Book. This book has been sectioned for your convenience and organized as follows:

SELECTION GUIDES

Quick reference guides and short form data for designers seeking devices to meet their needs. These selection guides are arranged by product to make the location of information easy. They also contain basic parameter information for each device and indicate the page number of the complete data sheet.

CHAPTERS 1 AND 2

Basic technical information concerning the structure and manufacture of optoelectronic devices, soldering and cleaning considerations for those devices, and the reliability of LED digits.

PRODUCT INFORMATION

Optoelectronic devices arranged in chapters by product type. Each chapter contains a short introduction to, and cross-reference index for, devices within a particular device category, and complete data sheets for individual devices.

The wide range of Fairchild-developed optoelectronic products, along with a deliberate program to second-source many popular configurations produced by other optoelectronic suppliers, affords Fairchild one of the broadest LED lamp, digit, display, and coupler product lines of any supplier. Products manufactured by Fairchild include direct-drive watch, clock, and multimeter displays, and multiplexed calculator, 16-segment alphanumeric, and dot-matrix displays.

Most of the products in this Data Book are multiple-sourced industry-standard devices with availability assured for years to come.

Not included in this book are Fairchild's liquid crystal display (LED) devices. Information on these is currently available in the optoelectronics short-form catalog, and a Data Book covering only LCDs is soon to be issued.

STANDARD DEFINITIONS OF SYMBOLS AND TERMS USED IN SPECIFYING OPTOELECTRONIC DEVICES

ADDRESSES OF FAIRCHILD SALES OFFICES, REPRESENTATIVES, AND DISTRIBUTORS

As well as supplying a full line of standard devices, Fairchild has the capability of supplying custom devices tailored to your application. A complete service organization is available to assist you: a sales force consisting of sales engineers, representatives, and distributors; field application engineers to help you with circuit design or device application; and customer service coordinators to expedite your order. Our goal is to give you reliable, cost-effective optoelectronic devices, timely delivery, and excellent service while maintaining our position on the leading edge of this field of expanding technology.

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LED VISIBLE LAMPS

Item	DEVICE NO.	Lens Characteristic	I_F mA Typ	Luminous Intensity $I_F = 20mA$ mcd Typ	V_F $I_F = 20mA$ V Typ	Package No.
1	**FLV104A**	Clear	100	(4.0mW/sr)	2.0	Opto-8
2	**FLV110**	Red Diffused	20	2.0	1.7	Opto-5
3	**FLV111**	Clear Point Source	20	2.0	1.7	Opto-5
4	**FLV112**	Clear Diffused	20	2.0	1.7	Opto-5
5	**FLV117**	Red Diffused	50	1.0	1.9	Opto-5
6	**FLV140**	Red Diffused	20	2.0	1.7	Opto-4
7	**FLV141**	Red Point Source	20	2.0	1.7	Opto-4
8	**FLV150**	Red Diffused	20	2.0	1.7	Opto-4
9	**FLV151**	Red Point Source	20	2.0	1.7	Opto-4
10	**FLV152**	Red Point Source	20	3.0	1.7	Opto-4
11	**FLV160**	Red Diffused	20	2.0	1.7	Opto-7
12	**FLV161**	Red Point Source	20	2.0	1.7	Opto-7
13	**FLV251**	Red Point Source	10	5.0	2.1	Opto-4
14	**FLV252**	Red Point Source	10	8.0	2.1	Opto-4
15	**FLV310**	Green Diffused	20	3.2	2.3	Opto-5
16	**FLV311**	Green Point Source	20	3.2	2.3	Opto-5
17	**FLV315**	Green Diffused	20	2.5	3.0	Opto-5
18	**FLV340**	Green Diffused	20	3.2	2.3	Opto-4
19	**FLV341**	Green Point Source	20	3.2	2.3	Opto-4
20	**FLV350**	Green Diffused	20	3.2	2.3	Opto-6
21	**FLV351**	Green Point Source	20	3.2	2.3	Opto-6
22	**FLV355**	Green Diffused	20	2.5	3.0	Opto-6
23	**FLV360**	Green Diffused	20	3.2	2.3	Opto-7
24	**FLV361**	Green Point Source	20	3.2	2.3	Opto-7
25	**FLV365**	Green Diffused	20	2.5	3.0	Opto-7
26	**FLV410**	Yellow Diffused	20	3.2	2.3	Opto-5
27	**FLV411**	Yellow Point Source	20	3.2	2.3	Opto-5
28	**FLV440**	Yellow Diffused	20	3.2	2.3	Opto-4
29	**FLV441**	Yellow Point Source	20	3.2	2.3	Opto-4

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LED VISIBLE LAMPS (Cont'd)

Item	DEVICE NO.	Lens Characteristic	I_F mA Typ	Luminous Intensity I_F = 20mA mcd Typ	V_F V Typ	Package No.
1	**FLV450**	Yellow Diffused	20	3.2	2.3	Opto-6
2	**FLV451**	Yellow Point Source	20	3.2	2.3	Opto-6
3	**FLV460**	Yellow Diffused	20	3.2	2.3	Opto-7
4	**FLV461**	Yellow Point Source	20	3.2	2.3	Opto-7
5	**FLV510**	Red Diffused	10	3.0	1.9	Opto-5
6	**FLV511**	Red Point Source	10	3.0	1.9	Opto-5
7	**FLV540**	Red Diffused	10	3.0	1.9	Opto-4
8	**FLV541**	Red Point Source	10	3.0	1.9	Opto-4
9	**FLV550**	Red Diffused	10	3.0	1.9	Opto-6
10	**FLV551**	Red Point Source	10	3.0	1.9	Opto-6
11	**FLV560**	Red Diffused	10	3.0	1.9	Opto-7
12	**FLV561**	Red Point Source	10	3.0	1.9	Opto-7
13	**MV5050**	Clear Point Source	20	2.0	1.7	Opto-9
14	**MV5051**	Clear Diffused	20	1.6	1.7	Opto-9
15	**MV5052**	Red Point Source	20	2.0	1.7	Opto-9
16	**MV5053**	Red Diffused	20	1.6	1.7	Opto-9
17	**MV5054-1**	Red Semi-Diffused	20	2.0	1.7	Opto-10
18	**MV5054-2**	Red Semi-Diffused	20	3.0	1.7	Opto-10
19	**MV5054-3**	Red Semi-Diffused	20	4.0	1.7	Opto-10
20	**MV5152**	Amber Point Source	20	16.0	1.9	Opto-10
21	**MV5153**	Amber Diffused	20	4.0	1.9	Opto-9
22	**MV5154**	Amber Semi-Diffused	20	8.0	1.9	Opto-10
23	**MV5252**	Green Point Source	20	6.0	2.3	Opto-10
24	**MV5253**	Green Diffused	20	1.5	2.3	Opto-9
25	**MV5254**	Green Semi-Diffused	20	3.0	2.3	Opto-10
26	**MV5352**	Yellow Point Source	20	10.0	2.3	Opto-10
27	**MV5353**	Yellow Diffused	20	6.0	2.3	Opto-9
28	**MV5354**	Yellow Semi-Diffused	20	10.0	2.3	Opto-10
29	**MV5752**	Red Point Source	20	16.0	1.9	Opto-10
30	**MV5753**	Red Diffused	20	4.0	1.9	Opto-9

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LED VISIBLE LAMPS (Cont'd)

Item	DEVICE NO.	Lens Characteristic	I_F mA Typ	Luminous Intensity I_F = 20mA mcd Typ	V_F V Typ	Package No.
1	**MV5754**	Red Semi-Diffused	20	8.0	1.9	Opto-10
2	**TIL209A**	Red Diffused T-1	20	2.0	1.7	Opto-11
3	**TIL211**	Green Diffused T-1	20	0.5	1.7	Opto-11
4	**TIL213**	Yellow Diffused T-1	20	0.5	1.7	Opto-11

LED LAMP MOUNTING HARDWARE

Item	DEVICE NO.	Panel Thickness	Panel Hole	Description	Package No.
5	**FLS010**	.060 to .250	.265 ±.002	Single-Part Construction (Flat Black Finish)	Opto-1
6	**FLS011**	0.187	.250 ±.003	3-Piece Construction: Hex Nut, Threaded Barrel and Bezel (Bezel in Silver Finish)	Opto-2
7	**FLS012**	0.187	.250 ±.003	3-Piece Construction: Hex Nut, Threaded Barrel and Bezel (Bezel in Black Finish)	Opto-2
8	**MP52**	0.125	.250 ±.003	Mounting Clip for MV Series Lamps	Opto-3

7-SEGMENT NUMERIC DISPLAYS

Item	DEVICE NO.	Character Height Inches	Polarity	Color	Description	Decimal Point	Peak Current/Seg Pulse = 100µs mA	V_F I_F = 20mA/Seg V	Luminous Intensity/Seg I_F = 20mA µcd	Logic/Connection Diagram	Package No.
9	**FND350**	0.362	CA	Red	7-Segment Display	RH	200	1.7	450	O1	Opto-12
10	**FND351**	0.362	CA	Red	Overflow ±1 Digit	RH	200	1.7	450	O2	Opto-12
11	**FND357**	0.362	CC	Red	7-Segment Display	RH	200	1.7	450	O1	Opto-12
12	**FND358**	0.362	CC	Red	Overflow ±1 Digit	RH	200	1.7	450	O2	Opto-12
13	**FND360**	0.362	CA	Red	7-Segment Display	RH	200	1.7	900	O1	Opto-12
14	**FND361**	0.362	CA	Red	Overflow ± Digit	RH	200	1.7	900	O2	Opto-12
15	**FND367**	0.362	CC	Red	7-Segment Display	RH	200	1.7	900	O1	Opto-12
16	**FND368**	0.362	CC	Red	Overflow ±1 Digit	RH	200	1.7	900	O2	Opto-12
17	**FND500**	0.500	CC	Red	7-Segment Display	RH	200	1.7	600	O3	Opto-13
18	**FND501**	0.500	CC	Red	Overflow ±1 Digit	RH	200	1.7	600	O4	Opto-13
19	**FND507**	0.500	CA	Red	7-Segment Display	RH	200	1.7	600	O3	Opto-13
20	**FND508**	0.500	CA	Red	Overflow ±1 Digit	RH	200	1.7	600	O4	Opto-13

OPTO

7-SEGMENT NUMERIC DISPLAYS (Cont'd)

Item	DEVICE NO.	Character Height Inches	Polarity	Color	Description	Decimal Point	Peak Current/Seg Pulse = 100μs mA	V_F $I_F = 20$mA/Seg V	Luminous Intensity/Seg $I_F = 20$mA μcd	Logic/Connection Diagram	Package No.
1	**FND530**	0.500	CC	Grn	7-Segment Display	RH	80	2.2	2000	O3	Opto-13
2	**FND531**	0.500	CC	Grn	Overflow ±1 Digit	RH	80	2.2	2000	O4	Opto-13
3	**FND537**	0.500	CA	Grn	7-Segment Display	RH	80	2.2	2000	O3	Opto-13
4	**FND538**	0.500	CA	Grn	Overflow ±1 Digit	RH	80	2.2	2000	O4	Opto-13
5	**FND540**	0.500	CC	Yel	7-Segment Display	RH	80	2.2	2000	O3	Opto-13
6	**FND541**	0.500	CC	Yel	Overflow ± Digit	RH	80	2.2	2000	O4	Opto-13
7	**FND547**	0.500	CA	Yel	7-Segment Display	RH	80	2.2	2000	O3	Opto-13
8	**FND548**	0.500	CA	Yel	Overflow ± Digit	RH	80	2.2	2000	O4	Opto-13
9	**FND550**	0.500	CC	Amb	7-Segment Display	RH	80	2.2	2000	O3	Opto-13
10	**FND551**	0.500	CC	Amb	Overflow ±1 Digit	RH	80	2.2	2000	O4	Opto-13
11	**FND557**	0.500	CA	Amb	7-Segment Display	RH	80	2.2	2000	O3	Opto-13
12	**FND558**	0.500	CA	Amb	Overflow ±1 Digit	RH	80	2.2	2000	O4	Opto-13
13	**FND560**	0.500	CC	Red	7-Segment Display	RH	200	2.2	1200	O3	Opto-13
14	**FND561**	0.500	CC	Red	Overflow ±1 Digit	RH	200	1.7	1200	O4	Opto-13
15	**FND567**	0.500	CA	Red	7-Segment Display	RH	200	1.7	1200	O3	Opto-13
16	**FND568**	0.500	CA	Red	Overflow ±1 Digit	RH	200	1.7	1200	O4	Opto-13
17	**FND800**	0.800	CC	Red	7-Segment Display	RH	200	1.7	600	O5	Opto-14
18	**FND807**	0.800	CA	Red	7-Segment Display	RH	200	1.7	600	O5	Opto-14
19	**FND847**	0.800	CA	Red	7-Segment Display	LH	200	1.7	600	O6	Opto-14
20	**FND850**	0.800	CC	Red	7-Segment Display	LH	200	1.7	600	O6	Opto-14
21	**FND6710**	0.560	CA	Red	Dual Digit Display	RH	200	1.7	500	O10	Opto-16
22	**FND6730***	0.560	CA	Red	1 1/2 Digit ±18 Display	RH	200	1.7	500	—	—
23	**FND6740**	0.560	CC	Red	Dual Digit Display	RH	200	1.7	500	O10	Opto-16
24	**FND6750***	0.560	CC	Red	1/2 Digit ±18 Display	RH	200	1.7	500	—	—
25	**MAN71A**	0.300	CA	Red	7-Segment Display	RH	200	1.7	450	O7	Opto-15
26	**MAN72A**	0.300	CA	Red	7-Segment Display	LH	200	1.7	450	O7	Opto-15
27	**MAN73A**	0.300	CA	Red	Overflow ±1 Digit	None	200	1.7	450	O8	Opto-15
28	**MAN74A**	0.300	CC	Red	7-Segment Display	RH	200	1.7	450	O9	Opto-15

* Available 2nd Half, 1978

OPTO

7-SEGMENT NUMERIC DISPLAY ARRAYS

Item	DEVICE NO.	Digits	AM/PM	V_F I_F = 8.0 mA V Typ	Luminous Intensity/Seg µcd Typ	@mA	Seg/Seg Match Typ	No. of Pins	Logic/ Connection Diagram	Package No.
1	**FCS6400**	4	No	1.7	200	10	±33%	34	O17	Opto-24
2	**FCS6401**	3½	Yes	1.7	200	10	±33%	34	O18	Opto-25
3	**FCS8000**	3½	Yes	1.65	350	8.0	±33%	34	O11	Opto-17
4	**FCS8024**	4	No	1.65	350	8.0	±33%	34	O12	Opto-18
5	**FNA3420**(3)	4	No	1.7	600	20	±33%	13	—	—
6	**FNA5420**	4	No	1.7	600	20	±33%	13	O13	Opto-20
7	**FNA5421**	3½	No	1.7	600	20	±33%	13	O14	Opto-21
8	**FNA5427**	4	No	1.7	600	20	±33%	13	O13	Opto-20
9	**FNA5428**	3½	No	1.7	600	20	±33%	13	O14	Opto-21
10	**FNA5520**	5	No	1.7	600	20	±33%	14	O15	Opto-22
11	**FNA5521**	4½	No	1.7	600	20	±33%	14	O16	Opto-23
12	**FNA5527**	5	No	1.7	600	20	±33%	14	O15	Opto-22
13	**FNA5528**	4½	No	1.7	600	20	±33%	14	O16	Opto-23

LIQUID CRYSTAL DISPLAYS

Always a leader in high-technology, state-of-the-art electronics, Fairchild has now entered the liquid crystal display (LCD) market. Initial entries are 3½-, 5½-, and 6-digit watch and 8-digit calculator displays, and the product range will continue to expand as customer needs and desires are identified.

In order to properly introduce the LCD products, and to ensure that only the most current data on this rapidly growing line is presented, a separate LCD Data Book is being prepared.

Until the new Data Book is available, please contact our factory for information on how the Fairchild LCDs can meet your needs.

OPTO

COUPLERS—TRANSISTOR OUTPUT

		MAX RATINGS @ T_A 25°C					
			Transistor		Diode		
Item	DEVICE NO.	P_D mW	I_C mA	V_{CEO} V	V_R V	I_F mA	V_{ISO} kV
1	**FCD810**(1)	250	25	20	3.0	60	1.5ac
2	**FCD810A**(1)	250	25	20	3.0	60	1.5
3	**FCD810B**(1)	250	25	20	3.0	60	2.5
4	**FCD810C**(1)	250	25	20	3.0	60	5.0
5	**FCD810D**(1)	250	25	20	3.0	60	6.0
6	**FCD820**(1,3)	250	25	30	3.0	60	1.5ac
7	**FCD820A**(1)	250	25	30	3.0	60	1.5
8	**FCD820B**(1)	250	25	30	3.0	60	2.5
9	**FCD820C**(1)	250	25	30	3.0	60	5.0
10	**FCD820D**(1)	250	25	30	3.0	60	6.0
11	**FCD825**(1,5)	250	25	30	3.0	60	1.5ac
12	**FCD825A**(1,5)	250	25	30	3.0	60	1.5
13	**FCD825B**(1,5)	250	25	30	3.0	60	2.5
14	**FCD825C**(1,5)	250	25	30	3.0	60	5.0
15	**FCD825D**(1,5)	250	25	30	3.0	60	6.0
16	**FCD830**(2,3)	250	25	30	3.0	60	1.5
17	**FCD830A**(2)	250	25	30	3.0	60	1.5ac
18	**FCD830B**(2)	250	25	30	3.0	60	2.5
19	**FCD830C**(2)	250	25	30	3.0	60	5.0

1. Standard transistor output
2. High speed transistor output
   guaranteed 2.0 μs max t_r and t_f with 100 Ω R_L
   8.0 μs typ at 1K Ω R_L
3. CTR guaranteed with transistor in saturation
4. JEDEC registered data and conditions
5. CTR typ at 1.0mA 40%

COUPLED CHARACTERISTICS				INPUT DIODE CHARACT.		OUTPUT TRANSISTOR CHARACT.			Logic/ Connection Diagram	Package No.
Min Current Transfer Ratio I_C/I_F %	@ I_F mA	@ V_{CE} V	t_r, t_f µs Typ	V_F V Max	@ I_F mA	$V_{CE(sat)}$ V Max	@ I_C mA	@ I_F mA		
10	10	10	4.0	1.5	10	0.7	2.6	50	O24	Opto-37
10	10	10	4.0	1.5	10	0.7	2.6	50	O24	Opto-37
10	10	10	4.0	1.5	10	0.7	1.6	50	O24	Opto-37
10	10	10	4.0	1.5	10	0.7	2.6	50	O24	Opto-37
10	10	10	4.0	1.5	10	0.7	2.6	50	O24	Opto-37
20	10	0.4	2.5	1.5	60	0.4	2.0	10	O24	Opto-37
20	10	10	2.5	1.5	60	0.4	2.2	15	O24	Opto-37
20	10	10	2.5	1.5	60	0.4	2.2	15	O24	Opto-37
20	10	10	2.5	1.5	60	0.4	2.2	15	O24	Opto-37
20	10	10	2.5	1.5	60	0.4	2.2	15	O24	Opto-37
50	10	10	3.0	1.5	60	0.4	2.0	10	O24	Opto-37
50	10	10	3.0	1.5	60	0.4	2.0	10	O24	Opto-37
50	10	10	3.0	1.5	60	0.4	2.0	10	O24	Opto-37
50	10	10	3.0	1.5	60	0.4	2.0	10	O24	Opto-37
50	10	10	3.0	1.5	60	0.4	2.0	10	O24	Opto-37
20	10	0.4	1.6	1.5	60	0.4	2.0	10	O24	Opto-37
20	10	10	1.6	1.5	60	0.4	2.2	15	O24	Opto-37
20	10	10	1.6	1.5	60	0.4	2.2	15	O24	Opto-37
20	10	10	1.6	1.5	60	0.4	2.2	15	O24	Opto-37

OPTO

COUPLERS—TRANSISTOR OUTPUT (Cont'd)

		MAX RATINGS @ T_A = 25°C					
			Transistor		Diode		
Item	DEVICE NO.	P_D mW	I_C mA	V_{CEO} V	V_R V	I_F mA	V_{ISO} kV
1	FCD830D(2)	250	25	30	3.0	60	6.0
2	FCD831(2)	250	25	30	3.0	60	1.5ac
3	FCD831A(2)	250	25	30	3.0	60	1.5
4	FCD831B(2)	250	25	30	3.0	60	2.5
5	FCD831C(2)	250	25	30	3.0	60	5.0
6	FCD831D(2)	250	25	30	3.0	60	6.0
7	FCD836(2)	250	25	20	3.0	60	1.5ac
8	FCD836C(2)	250	25	20	3.0	60	5.0
9	FCD836D(2)	250	25	20	3.0	60	6.0
10	4N25(4)	250	—	30	3.0	80	2.5
11	4N26(4)	250	—	30	3.0	80	1.5
12	4N27(4)	250	—	30	3.0	80	1.5
13	4N28(4)	250	—	30	3.0	80	0.5
14	4N35(4)	400	—	30	6.0	60	3.5
15	4N36(4)	400	—	30	6.0	60	2.5
16	4N37(4)	400	—	30	6.0	60	1.5
17	IL1	200	—	30	3.0	150	2.5
18	IL12	200	—	30	3.0	150	1.0
19	IL15	200	—	30	3.0	150	1.5

1. Standard transistor output
2. High speed transistor output
   guaranteed 2.0 μs max t_r and t_f with 100 Ω R_L
   8.0 μs typ at 1K Ω R_L
3. CTR guaranteed with transistor in saturation
4. JEDEC registered data and conditions
5. CTR typ at 1.0mA = 40%

COUPLED CHARACTERISTICS				INPUT DIODE CHARACT.		OUTPUT TRANSISTOR CHARACT.			Logic/ Connection Diagram	Package No.
Min Current Transfer Ratio I_C/I_F %	@I_F mA	@V_{CE} V	t_r, t_f µs Typ	V_F V Max	@I_F mA	$V_{CE(sat)}$ V Max	@I_C mA	@I_F mA		
20	10	10	1.6	1.5	60	0.4	2.2	15	O24	Opto-37
10	10	10	1.6	1.5	60	0.5	2.0	50	O24	Opto-37
10	10	10	1.6	1.5	60	0.5	2.0	50	O24	Opto-37
10	10	10	1.6	1.5	60	0.5	2.0	50	O24	Opto-37
10	10	10	1.6	1.5	60	0.5	2.0	50	O24	Opto-37
10	10	10	1.6	1.5	60	0.5	2.0	50	O24	Opto-37
6.0	10	10	1.6	1.5	20	0.7	2.0	50	O24	Opto-37
6.0	10	10	1.6	1.5	20	0.7	2.0	50	O24	Opto-37
6.0	10	10	1.6	1.5	20	0.7	2.0	50	O24	Opto-37
20	10	10	2.5	1.5	50	0.5	2.0	50	O24	Opto-37
20	10	10	2.5	1.5	50	0.5	2.0	50	O24	Opto-37
10	10	10	2.5	1.5	50	0.5	2.0	50	O24	Opto-37
10	10	10	2.5	1.5	50	0.5	2.0	50	O24	Opto-37
100	10	10	8.0	1.5	10	0.3	0.5	10	O24	Opto-37
100	10	10	8.0	1.5	10	0.3	0.5	10	O24	Opto-37
100	10	10	8.0	1.5	10	0.3	0.5	10	O24	Opto-37
20	10	10	2.0	1.5	60	0.5	1.6	16	O24	Opto-37
10	10	5.0	2.0	1.5	10	0.5	2.0	50	O24	Opto-37
6.0	10	10	2.0	1.5	60	0.5	2.0	50	O24	Opto-37

OPTO

COUPLERS—TRANSISTOR OUTPUT (Cont'd)

		MAX RATINGS @ T_A = 25°C					
			Transistor		Diode		
Item	DEVICE NO.	P_D mW	I_C mA	V_{CEO} V	V_R V	I_F mA	V_{ISO} kV
1	**IL16**	200	—	30	3.0	150	1.5
2	**IL74**	150	—	20	3.0	150	1.5
3	**H11A1**	250	100	30	3.0	60	2.5
4	**H11A2**	250	100	30	3.0	60	1.5
5	**H11A3**	250	100	30	3.0	60	2.5
6	**H11A4**	250	100	30	3.0	60	1.5
7	**MCT2**	250	—	30	3.0	60	1.5
8	**MCT2E**	250	—	30	3.0	60	2.5
9	**MCT26**	250	—	30	3.0	60	1.5
10	**TIL111**$^{(3)}$	250	—	30	3.0	100	1.5
11	**TIL112**	250	—	20	3.0	100	1.5
12	**TIL114**$^{(3)}$	250	—	30	3.0	100	2.5
13	**TIL115**	250	—	20	3.0	100	2.5
14	**TIL116**	250	—	30	3.0	100	2.5
15	**TIL117**	250	—	30	3.0	100	2.5
16	**TIL118**	250	—	20	3.0	100	1.5
17	**MOC1000**	250	—	30	3.0	80	1.5
18	**MOC1001**	250	—	30	3.0	80	2.5
19	**MOC1002**	250	—	30	3.0	80	1.5
20	**MOC1003**	250	—	30	3.0	80	0.5

1. Standard transistor output
2. High speed transistor output
   guaranteed 2.0 μs max t_r and t_f with 100 Ω R_L
   8.0 μs typ at 1K Ω R_L
3. CTR guaranteed with transistor in saturation
4. JEDEC registered data and conditions
5. CTR typ at 1.0mA = 40%

COUPLED CHARACTERISTICS				INPUT DIODE CHARACT.		OUTPUT TRANSISTOR CHARACT.			Logic/ Connection Diagram	Package No.
Min Current Transfer Ratio I_C/I_F %	@ I_F mA	@ V_{CE} V	t_r, t_f μs Typ	V_F V Max	@ I_F mA	V_{CE}(sat) V Max	@ I_C mA	@ I_F mA		
6.0	10	10	2.0	1.5	60	0.5	1.6	50	O24	Opto-37
12.5	16	5.0	25.0	—	—	0.5	2.0	16	O24	Opto-37
50	10	10	2.0	1.5	10	0.4	0.5	10	O24	Opto-37
20	10	10	2.0	1.5	10	0.4	0.5	10	O24	Opto-37
20	10	10	2.0	1.5	10	0.4	0.5	10	O24	Opto-37
10	10	10	2.0	1.5	10	0.4	0.5	10	O24	Opto-37
20	10	10	2.5	1.5	20	0.4	2.0	16	O24	Opto-37
20	10	10	2.5	1.5	20	0.4	2.0	16	O24	Opto-37
6.0	10	10	2.0	1.5	20	0.5	1.6	60	O24	Opto-37
12	16	0.4	5.0	1.4	16	0.4	2.0	16	O24	Opto-37
2.0	10	5.0	15.0	1.5	10	0.5	2.0	50	O24	Opto-37
12	16	0.4	5.0	1.4	16	0.4	2.0	16	O24	Opto-37
2.0	10	5.0	15.0	1.5	10	0.5	2.0	50	O24	Opto-37
20	10	10	7.0	1.5	60	0.4	2.2	15	O24	Opto-37
50	10	10	9.0	1.4	16	0.4	0.5	10	O24	Opto-37
10	10	5.0	15.0	1.5	10	0.5	2.0	50	O24	Opto-37
20	10	10	2.8	1.5	50	0.5	2.0	50	O24	Opto-37
20	10	10	2.8	1.5	50	0.5	2.0	50	O24	Opto-37
10	10	10	2.8	1.5	50	0.5	2.0	50	O24	Opto-37
10	10	10	2.8	1.5	50	0.5	2.0	50	O24	Opto-37

OPTO

COUPLERS—DARLINGTON OUTPUT

		MAX RATINGS @ T_A = 25°C					
			Transistor		Diode		
Item	DEVICE NO.	P_D mW	I_C mA	V_{CEO} V	V_R V	I_F mA	V_{ISO} kV
1	**FCD850**	250	125	30	3.0	80	1.5ac
2	**FCD850C**	250	125	30	3.0	80	5.0
3	**FCD850D**	250	125	30	3.0	80	6.0
4	**FCD855**	250	125	55	3.0	80	1.5ac
5	**FCD855C**	250	125	55	3.0	80	5.0
6	**FCD855D**	250	125	55	3.0	80	6.0
7	**FCD860**(3)	250	125	30	3.0	80	1.5ac
8	**FCD860C**(3)	250	125	30	3.0	80	5.0
9	**FCD860D**(3)	250	125	30	3.0	80	6.0
10	**FCD865**(3)	250	125	30	3.0	80	1.5ac
11	**FCD865C**(3)	250	125	30	3.0	80	5.0
12	**FCD865D**(3)	250	125	30	3.0	80	6.0
13	**4N29**(4)	250	125	30	3.0	80	2.5
14	**4N30**(4)	250	125	30	3.0	80	1.5
15	**4N31**(4)	250	125	30	3.0	80	1.5
16	**4N32**(4)	250	125	30	3.0	80	2.5
17	**4N33**(4)	250	125	30	3.0	80	1.5
18	**H11B1**	250	100	25	3.0	60	2.5
19	**H11B2**	250	100	25	3.0	60	1.5
20	**TIL113**(3)	250	—	30	3.0	100	1.5
21	**TIL119**	250	—	30	3.0	100	1.5
22	**MCA230**	250	—	30	3.0	60	1.5
23	**MCA231**(3)	250	50	30	3.0	60	1.5
24	**MCA255**	250	—	55	3.0	60	1.5

1. Standard transistor output
2. High speed transistor output
   guaranteed 2 μs max t_r and t_f with 100Ω R_L
   8μs typ at 1KΩ R_L
3. CTR guaranteed with transistor in saturation
4. JEDEC registered data and conditions
5. CTR typ at 1.0mA = 40%

COUPLED CHARACTERISTICS					INPUT DIODE CHARACT.		OUTPUT DARLINGTON CHARACT.		Logic/ Connection Diagram	Package No.
Min Current Transfer Ratio										
I_C/I_F %	@ I_F mA	@ V_{CE} V	t_r μs Typ	t_f μs Typ	V_F V Max	@ I_F mA	I_{CEO} μA Max	@ V_{CE} V		
100	10	5.0	15	150	1.5	20	0.1	10	O24	Opto-37
100	10	5.0	15	150	1.5	20	0.1	10	O24	Opto-37
100	10	5.0	15	150	1.5	20	0.1	10	O24	Opto-37
100	10	5.0	15	150	1.5	20	0.1	10	O24	Opto-37
100	10	5.0	15	150	1.5	20	0.1	10	O24	Opto-37
100	10	5.0	15	150	1.5	20	0.1	10	O24	Opto-37
200	1.0	1.0	80	150	1.5	20	0.1	10	O24	Opto-37
200	1.0	1.0	80	150	1.5	20	0.1	10	O24	Opto-37
200	1.0	1.0	80	150	1.5	20	0.1	10	O24	Opto-37
400	0.5	1.0	80	150	1.5	20	0.1	10	O24	Opto-37
400	0.5	1.0	80	150	1.5	20	0.1	10	O24	Opto-37
400	0.5	1.0	80	150	1.5	20	0.1	10	O24	Opto-37
100	10	10	10	45	1.5	50	0.1	10	O24	Opto-37
100	10	10	10	45	1.5	50	0.1	10	O24	Opto-37
50	10	10	10	45	1.5	50	0.1	10	O24	Opto-37
500	10	10	10	120	1.5	50	0.1	10	O24	Opto-37
500	10	10	10	120	1.5	50	0.1	10	O24	Opto-37
500	1.0	5.0	125	100	1.5	10	0.1	10	O24	Opto-37
200	1.0	5.0	125	100	1.5	10	0.1	10	O24	Opto-37
300	10	1.0	50	50	1.5	10	0.1	10	O24	Opto-37
300	10	2.0	50	50	1.5	10	0.1	10	O24	Opto-37
100	10	5.0	5.0	35	1.5	20	0.1	10	O24	Opto-37
200	5.0	1.0	5.0	35	1.5	10	0.1	10	O24	Opto-37
100	10	5.0	5.0	35	1.5	20	0.1	10	O24	Opto-37

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PHOTO TRANSISTORS

Item	DEVICE NO.	Description	V_{CEO} I_C = 1.0mA V		$I_{CE(lt)}$ V_{CE} = 5.0V mA			$V_{CE(sat)}$ H = 20mW/cm^2 V			t_r/t_f µs	Package No.
			Min	Typ	Min	Typ	Max	Min	Typ	Max	Typ	
1	**FPT100**	Plastic, Dome Lens General Purpose	30	50	H = 5.0mW/cm^2 0.2	1.4	—	I_C = 500µA —	0.16	0.3	2.8	Opto-26
2	**FPT100A**	Plastic, Dome Lens 1:3 Sensitivity	30	50	H = 5.0mW/cm^2 1.0	1.4	3.0	I_C = 500µA —	0.16	0.3	2.8	Opto-26
3	**FPT100B**	Plastic, Dome Lens 1:2 Sensitivity	30	50	H = 5.0mW/cm^2 1.3	1.4	2.6	I_C = 500µA —	0.16	0.3	2.8	Opto-26
4	**FPT101**	Miniature, .080" Dia. Hermetic Package	I_C = 0.1mA, H ≤ 0.1µW/cm^2 30	60	H = 20mW/cm^2 0.8	3.5	—	I_C = 0.4mA —	0.25	0.3	2.8	Opto-27
5	**FPT102**	Photodiode Hermetic Package	I_R = 5.0µA, H ≤ 0.1µW/cm^2 50	120	V_R = −10.0V, H ≤ 0.1µW/cm^2 —	0.1nA	25nA	V_R = −10V 12µA	20µA	—	0.2	Opto-27
6	**FPT110**	Plastic Flat Lens General Purpose	30	50	H = 5.0mW/cm^2 0.2	0.88	—	I_C = 500µA —	0.16	0.33	2.8	Opto-28
7	**FP110A**	Plastic Flat Lens 1:3 Sensitivity	30	50	H = 5.0mW/cm^2 0.6	0.88	1.8	I_C = 500µA —	0.16	0.33	2.8	Opto-28
8	**FPT110B**	Plastic Flat Lens 1:2 Sensitivity	30	50	H = 5.0mW/cm^2 0.8	0.88	1.6	I_C = 500µA —	0.16	0.33	2.8	Opto-28
9	**FPT120**	Plastic, Dome Lens High Sensitivity	20	50	H = 1.0mW/cm^2 0.4	1.5	—	I_C = 1.0mA —	0.25	0.55	18	Opto-26
10	**FPT120A**	Plastic, Dome Lens 1:3 Sensitivity	15	30	H = 1.0mW/cm^2 1.5	2.4	4.5	I_C = 1.0mA —	0.25	0.55	18	Opto-26
11	**FPT120B**	Plastic, Dome Lens 1:1.5 Sensitivity	15	30	H = 1.0mW/cm^2 2.0	2.4	4.0	I_C = 1.0mA —	0.25	0.55	18	Opto-26
12	**FPT120C**	Plastic Cup, Dome Lens	11	20	H = 5.0mW/cm^2 16	—	25	I_C = 1.0mA —	0.35	0.55	18	Opto-26
13	**FPT130**	Plastic, Flat Lens High Sensitivity	20	50	H = 1.0mW/cm^2 0.4	0.9	—	I_C = 1.0mA —	0.25	0.55	18	Opto-28
14	**FPT130A**	Plastic, Flat Lens 1:3 Sensitivity	15	30	H = 1.0mW/cm^2 0.9	1.5	2.7	I_C = 1.0mA —	0.25	0.55	18	Opto-28
15	**FPT130B**	Plastic, Flat Lens 1:2 Sensitivity	15	30	H = 1.0mW/cm^2 1.2	1.5	2.4	I_C = 1.0mA —	0.25	0.55	18	Opto-28
16	**FPT131**	Plastic, Dome Lens	15	50	H = 5.0mW/cm^2 0.1	1.4	—	I_C = 500µA —	0.16	0.7	2.8	Opto-26
17	**FPT132**	Plastic, Dome Lens	10	30	H = 1.0mW/cm^2 0.2	1.5	—	I_C = 1.0mA —	0.15	0.7	18	Opto-26
18	**FPT136**	Plastic, Flat Lens	15	50	H = 5.0mW/cm^2 0.1	0.88	—	I_C = 500µA —	0.16	0.7	2.8	Opto-28

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PHOTO TRANSISTORS (Cont'd)

Item	DEVICE NO.	Description	V_{CEO} $I_C = 1.0mA$ V Min	Typ	$I_{CE(lt)}$ $V_{CE} = 5.0V$ mA Min	Typ	Max	$V_{CE(sat)}$ $H = 20mW/cm^2$ V Min	Typ	Max	t_r/t_f µs Typ	Package No.
1	**FPT137**	Plastic, Flat Lens	10	30	$H = 1.0mW/cm^2$ 0.2	0.9	—	$I_C = 1.0mA$ —	0.15	0.7	18	Opto-28
2	**FPT220**	Plastic, Dome Lens 1:2 Sensitivity	20	50	$H = 1.0mW/cm^2$ 1.0	1.5	2.0	$I_C = 1.0mA$ —	0.25	0.55	18	Opto-26
3	**FPT230**	Plastic Flat Lens 1:2 Sensitivity	20	50	$H = 1.0mW/cm^2$ 0.6	0.9	1.2	$I_C = 1.0mA$ —	0.25	0.55	18	Opto-28
4	**FPT320**	Plastic, Dome Lens 1:3 Sensitivity	20	50	$H = 1.0mW/cm^2$ 0.75	1.5	2.25	$I_C = 1.0mA$ —	0.25	0.55	18	Opto-26
5	**FPT330**	Plastic, Flat Lens 1:3 Sensitivity	20	50	$H = 1.0mW/cm^2$ 0.45	0.9	1.35	$I_C = 1.0mA$ —	0.25	0.55	18	Opto-28
6	**FPT400**	Plastic, Dome Lens Photo Darlington	30	50	$H = 1.0mW/cm^2$ 7.5	12	—	—	0.9	1.0	100	Opto-26
7	**FPT410**	Plastic, Flat Lens Photo Darlington	30	50	$H = 1.0mW/cm^2$ 5.0	8.0	—	—	0.9	1.0	100	Opto-28
8	**FPT500**	TO-18, Dome Lens	45	60	$H = 1.0mW/cm^2$ 1.0	—	—	—	0.2	0.33	3.0	Opto-29
9	**FPT500A**	TO-18, Dome Lens 1:3 Sensitivity	45	60	$H = 1.0mW/cm^2$ 2.0	—	6.0	—	0.2	0.33	3.0	Opto-29
10	**FPT510**	TO-18, Flat Lens	45	60	$H = 5.0mW/cm^2$ 0.5	—	—	—	0.2	0.33	3.0	Opto-30
11	**FPT510A**	TO-18, Flat Lens 1:3 Sensitivity	45	60	$H = 5.0mW/cm^2$ 1.0	—	3.0	—	0.2	0.33	3.0	Opto-30
12	**FPT520**	TO-18, Dome Lens	30	50	$H = 1.0mW/cm^2$ 5.0	—	—	—	0.2	0.33	10	Opto-29
13	**FPT520A**	TO-18, Dome Lens 1:3 Sensitivity	30	50	$H = 1.0mW/cm^2$ 6.0	—	18	—	0.2	0.33	10	Opto-29
14	**FPT530**	TO-18, Flat Lens	30	50	$H = 5.0mW/cm^2$ 3.0	—	—	—	0.2	0.33	10	Opto-30
15	**FPT530A**	TO-18, Flat Lens 1:3 Sensitivity	30	50	$H = 5.0mW/cm^2$ 4.0	—	12	—	0.2	0.33	10	Opto-30
16	**FPT540**	TO-18, Dome Lens	12	20	$H = 1.0mW/cm^2$ 8.0	—	—	—	0.35	0.55	18	Opto-29
17	**FPT540A**	TO-18, Dome Lens 1:3 Sensitivity	12	20	$H = 1.0mW/cm^2$ 10	—	30	—	0.35	0.55	18	Opto-29
18	**FPT550**	TO-18, Flat Lens	12	20	$H = 5.0mW/cm^2$ 8.0	—	—	—	0.35	0.55	18	Opto-30

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PHOTO TRANSISTORS (Cont'd)

Item	DEVICE NO.	Description	V_{CEO} $I_C = 1.0mA$ V		$I_{CE(lt)}$ $V_{CE} = 5.0V$ mA			$V_{CE(sat)}$ $H = 20mW/cm^2$ V			t_r/t_f µs Typ	Package No.
			Min	Typ	Min	Typ	Max	Min	Typ	Max		
1	**FPT550A**	TO-18, Flat Lens 1:3 Sensitivity	12	20	$H = 5.0mW/cm^2$ 8.0	—	24	—	0.35	0.55	18	Opto-30
2	**FPT560**	TO-18, Dome Lens Photo Darlington	30	50	$H = 0.5mW/cm^2$ 10	15	—	—	0.9	1.0	100	Opto-29
3	**FPT570**	TO-18, Flat Lens Photo Darlington	30	50	$H = 0.5mW/cm^2$ 1.0	6.0	—	—	0.9	1.0	100	Opto-30
4	**FPT610**	Miniature, .085" x .150"	30	50	$H = 5.0mW/cm^2$ 0.2	1.4	—	$I_C = 500\mu A$ —	0.16	0.3	2.8	Opto-31
5	**FPT630**	X .095" Tall Flat Lens	20	50	$H = 1.0mW/cm^2$ 0.4	0.9	—	$I_C = 1.0mA$ —	0.25	0.55	18	Opto-31

INFRARED EMITTERS

Item	DEVICE NO.	Description	I_F mA Max	V_F $I_F = 100mA$ V Typ	Wave Length @ Peak Emission nm Typ	Axial Intensity $I_F = 100mA$ mW/sr Typ	Package No.
6	**FPE100**	Metal Header Package Wide Beam	100	1.35	890	0.3	Opto-32
7	**FPE104**	Lead Frame Package Narrow Beam	100	1.35	890	10	Opto-8
8	**FPE106**	Miniature .085" x .150" x .095" Tall Flat Lens	100	1.35	890	0.4	Opto-31
9	**FPE500**	TO-18, Dome Lens	250	1.35	890	10.0	Opto-29
10	**FPE510**	TO-18, Flat Lens	250	1.35	890	1.0	Opto-30
11	**FPE520**	TO-18, Dome Lens	250	1.35	940	50	Opto-29
12	**FPE530**	TO-18, Flat Lens	250	1.35	940	5.0	Opto-30

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SOURCE/SENSOR ARRAYS

			Source		Sensor		Matching Factor		
Item	DEVICE NO.	Description	I_F mA/cell Max	V_F $I_F = 50mA$ V Typ	$I_{CE(lt)}$ $H = 1.0mW/cm^2$ $V_{CE} = 5.0V$ mA Typ	$V_{CE(sat)}$ (GaAs) $I_{CE} = 4.0mA$ V Typ	$\frac{I_{OUT(Min)}}{I_{OUT(Max)}}$ $I_F = 50mA$, $V_{CE} = 5.0V$ distance = 0.05" Min	Typ	Package No.
1	**FPA100**	9-Element Source/ Sensor Array 0.100" Centers	75	1.25	4.5	0.4	0.5	0.65	Opto-33 (2 pcs.)
2	**FPA101**	12-Element Source/ Sensor Array 0.250" Centers	75	1.25	4.5	0.4	0.5	0.65	Opto-34 (2 pcs.)
3	**FPA102**	10-Element Source/ Sensor Array 0.087" Centers	75	1.25	4.5	0.4	0.5	0.65	Opto-35 (2 pcs.)

SENSOR ARRAYS

							Matching Factor		
Item	DEVICE NO.	Description	I_{CE} mA Max	V_{CEO} $I_C = 1.0mA$ V Typ	$I_{CE(lt)}$ $H = 10mW/cm^2$ Tung.@ 2854°K mA Typ	$V_{CE(sat)}$ $H = 20mW/cm^2$ $I_C = 500mA$ V Typ	$\frac{I_{OUT(Min)}}{I_{OUT(Max)}}$ $I_F = 50mA$, $V_{CE} = 5.0V$ distance = 0.05" Min	Typ	Package No.
4	**FPA700**	9-Element Sensor Array 0.100" Centers	25	20	1.75	0.16	0.5	0.65	Opto-33
5	**FPA700A**	9-Element Sensor Array 0.100" Centers	25	20	1.75	0.16	0.75	0.85	Opto-33
6	**FPA710**	12-Element Sensor Array 0.250" Centers	25	20	1.75	0.16	0.5	0.65	Opto-34
7	**FPA710A**	12-Element Sensor Array 0.250" Centers	25	20	1.75	0.16	0.75	0.85	Opto-34
8	**FPA720**	10-Element Sensor Array 0.087" Centers	25	20	1.75	0.16	0.5	0.65	Opto-35
9	**FPA720A**	10-Element Sensor Array 0.87" Centers	25	20	1.75	0.16	0.75	0.85	Opto-35

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REFLECTIVE SENSORS

Item	DEVICE NO.(1)	Description	Diode I_F mA Max	Diode V_F $I_F = 20mA$ V Typ	Photo-Transistor V_{CEO} $I_{CE} = 1.0mA$ V Min	Combined I_{OUT} $I_F = 50mA$, $V_{CE} = 5V$ distance = .40" µA Min	Combined I_{OUT} µA Max	Package No.
1	**FPA103/106**	Light Reflective Transducer	75	1.25	12	20	—	Opto-36
2	**FPA104/107**	Light Reflective Transducer	75	1.25	12	60	180	Opto-36
3	**FPA105/108**	Light Reflective Transducer	75	1.25	12	80	160	Opto-36

DICE

Item	DEVICE NO.	Die Size Inches	Description
4	**FLX2121**	.015 x .015	A high-efficiency, long life red GaAsP LED. Typical luminous intensity = 0.7 mcd @ $V_F = 1.7$ V and $I_F = 20$ mA.
5	**FNX8019**	.116 x .070	GaAsP monolithic 7/9 segment display with a 5° slant. Dimensions given are digit sizes—die is larger by .008" vertical and no more than .016" in horizontal direction. Half digits (numeral-one) are available for the 0.100", and 0.116" display. The FNX8019, 8009 and 8039 are 9-segment and can be used as 7-segment. The other is 7-segment only.
6	**FNX8009**	.100 x .062	
7	**FNX8039**	.080 x .049	
8	**FNX8041**	.040 x .026	
9	**FNX8209**	.050 x .063	A current-sinking digit driver for common-cathode LED displays. The monolithic chip contains four independent npn transistors, each capable of sinking 63 mA with $I_B = 1.0$ mA.
10	**FPX1010**	.040 x .040	An npn Planar(2) phototransistor, $h_{FE} = 100$ Min; $V_{CEO} = 30$ V Min; $V_{CBO} = 50$ V Min; $I_{CE(lt)} = 0.3$ mA Min @ H = 5.0 mW/cm^2 (tungsten @ 2854° K); typical t_r and $t_f = 3.0$ µs @ $I_{CE} = 4.0$ mA and $R_L = 100$ Ω; $V_{CE(sat)} = 0.4$ V Max @ $I_C = 500$ µA.
11	**FPX1011**	.040 x .040	An npn Planar phototransistor with high illumination sensitivity $h_{FE} = 500$ Min; $V_{CEO} = 12$ V Min; $V_{CBO} = 30$ V Min; $I_{CE(lt)} = 0.3$ mA Min @ H = 1.0 mW/cm^2 (tungsten @ 2854° K), typical t_r and $t_f = 18$ µs @ $I_{CE} = 4.0$ mA and $R_L = 100$ Ω; $V_{CE(sat)} = 0.5$ V Max @ $I_C = 500$ µA.

1. FPA 106, 107, 108 have infrared filters.
2. Planar is a patented Fairchild process.

OPTOELECTRONIC TECHNOLOGY

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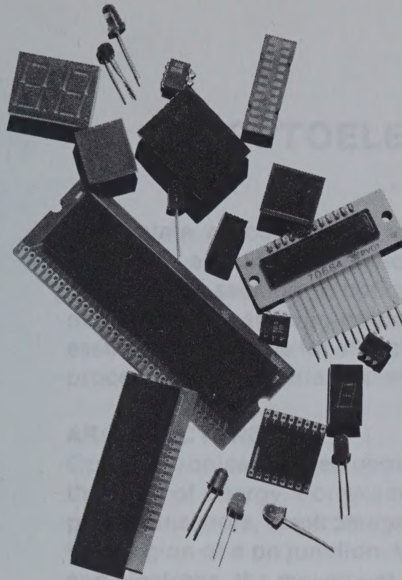
[illegible]	[illegible]	[illegible]	Diode [illegible]	Diode [illegible]	Photo-Transistor [illegible] Min	Combined [illegible] Min	Combined [illegible] Max	Package No.
[illegible]	[illegible]	[illegible]	[illegible]	1.25	[illegible]	[illegible]	[illegible]	Opto [illegible]
[illegible]	[illegible]	[illegible]	[illegible]	1.25	[illegible]	[illegible]	[illegible]	Opto [illegible]
[illegible]	[illegible]	[illegible]	[illegible]	1.25	[illegible]	[illegible]	[illegible]	Opto [illegible]

[illegible]	[illegible]	[illegible]	Description
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]



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CHAPTER 1
OPTOELECTRONIC TECHNOLOGY

Solid state optoelectronic technology has significantly improved the capabilities, reliability, and life expectancy of all types of displays and indicators. Several techniques, each seeking to optimize a different set of parameters, have been developed for manufacturing specific optoelectronic devices. Preparation of the basic materials is essentially the same for all techniques, with the major differences being in the assembly processes and materials selected for final device fabrication.

ARCHITECTURE

Optoelectronics is based upon the ability of certain semiconductor materials to change the form of energy. For example, in such light-sensitive devices as photodiodes and phototransistors, electromagnetic energy in the form of photons is absorbed by the p-type region of a pn junction. When absorbed in this manner, the protons release holes and electrons; the movement of the released electrons across the junction constitutes the current produced by the device.

The complementary device is the light-emitting diode (LED). The structure of the LED is such that, when current is applied to it, electrons and holes combine and effectively annihilate one another as charge carries. The energy is released from the LED in the form of photons. As would be expected, different semiconductor materials have different absorption and emission characteristics.

Generally, LED devices emitting light in the visble spectrum consist of a gallium arsenide (GaAs) or gallium phosphide (GaP) substrate with an epitaxial layer (a single crystal, grown on the substrate, that duplicates the orientation of the substrate) of gallium arsenide phosphide (GaAs) tailored to give the desired color and light emission characteristics. the GaAs and GaP materials are frequently referred to as III—V compounds because of their positions in the chemical periodic table. Devices that emit light in the infrared spectrum (IRLED's) typically are formed by diffusing an element, such as zinc, into a gallium arsenide compound.

Photodiodes and phototransistors use either bulk or epitaxial silicon, depending upon the final device configuration and desired characteristics. Optically coupled isolators consist of a GaAs infrared LED and a silicon phototransistor that are electrically isolated but optically coupled.

CRYSTAL GROWTH

The majority of visible LED products have a gallium arsenide substrate. The single crystals necessary for reproducible-device manufacture are prepared by either a Bridgman or Czochralski method. In the former, a seed of single-crystal GaAs, previously prepared and oriented in the appropriate crystal-line direction, is placed in a "boat" that has a semi-cylindrical cross-section. The boat is placed at one end of a quartz reaction vessel into which, at a high temperature (approximately 1250° C), is introduced high-purity gallium and arsenic. The gallium and arsenic combine and, with the continued application of heat, become a homogenous liquid. As the heat source is slowly moved away from the seed end of the vessel, a crystal begins to grow onto the seed. If all parameters are correct, the new crystal assumes the orientation of the seed. To give the crystal the desired electrical properties, the material is doped with special impurity atoms. Unwanted impurities are held to a level of less than one part per million.

In the Czochralski method, polycrystalline GaAs material is first synthesized separately, using the Bridgman technique. This material is then placed in a quartz cup or crucible, covered with liquid glass, and melted. An overpressure of inert gas over the glass prevents the gallium arsenide from breaking down into separate elements. A seed crystal, prepared in a manner similar to that used in the Bridgman technique, is lowered on a rotating rod to the surface of the molten GaAs. When the correct temperature has been established, the rotating seed is slowly pulled up, causing a crystal to grow onto it. The diameter and shape of the new crystal are determined by controlling the temperature of the liquid GaAs and the speed with which the seed is raised; electrical properties are determined by doping. Gallium phosphide single-crystal ingots are produced by the Czochralski method in much the same manner as gallium arsenide crystals, except that a higher liquid temperature and much greater overpressure are required.

The Czochralski process takes a great deal of operator skill and experience, but can be used to grow larger and longer crystals than is possible with the Bridgman technique. The Bridgman method, however, lends itself more readily to automation. At Fairchild, both techniques are used to achieve an optimum product mix and the lowest possible materials cost.

PROCESSING

After the single-crystal ingot has cooled, it is visually inspected and its electrical properties measured. The ingot is then placed on a precision diamond saw, aligned with a laser to the orientation needed for the next process step (epitaxy), and a slice removed from the exposed end. This slice is examined with an x-ray diffractometer to verify that proper orientation has been achieved. If orientation is correct, the entire ingot is cut into thin slices. These slices are cleaned, lapped, and chemically polished to a damage-free finish. After a final cleaning, the slices, or substrate wafers, are inspected for thickness, parallelism, and polish quality.

EPITAXY

In one of the most critical steps in the LED manufacturing process, each polished GaAs or GaP substrate wafer next has an epitaxial layer deposited on it. This layer is an alloy of GaAs and GaP, the final composition of which determines the color of the light emitted by the LED.

To grow the epitaxial layer, the wafer is placed in a chemical vapor deposition (CVD) reactor, through which gases can flow. The wafer is heated in hydrogen and etched with hydrogen chloride gas to clean its surfaces to a greater degree than is possible with mechanical devices in air. Very-high-purity atoms of arsenic, phosphorous, gallium, and dopant material are then deposited on the wafer in a manner that duplicates the single-crystal nature of the wafer. The composition of the alloy is varied to attain the desired final composition, with the dopant depositing the correct amount of impurity atoms in the layer.

With the layer deposited, the epitaxial wafer is inspected and tested to ensure that it emits the correct light color. The epi wafer then becomes the starting material for the wafer fabrication process.

WAFER FABRICATION

The first step in wafer fabrication is growing a layer of silicon nitride over the epi-wafer surface. Windows are then defined on the wafer using photolithographic techniques, and the necessary impurities diffused into the surface at a high temperature. The shape of the junctions thus formed is dictated by the type of device being manufactured. The nitride layer not only defines the junctions, or dice, but also provides passivation to ensure long-term reliability and high light output.

Again using photolithography, aluminum metal patterns are deposited on the wafer to make contact with the dice. The wafer is then lapped from its back side to a final thickness, which depends upon required die size. Gold and germanium are evaporated onto the back of the wafer and alloyed into the substrate in a furnance. A final layer of gold is applied to provide the best surface for subsequent steps.

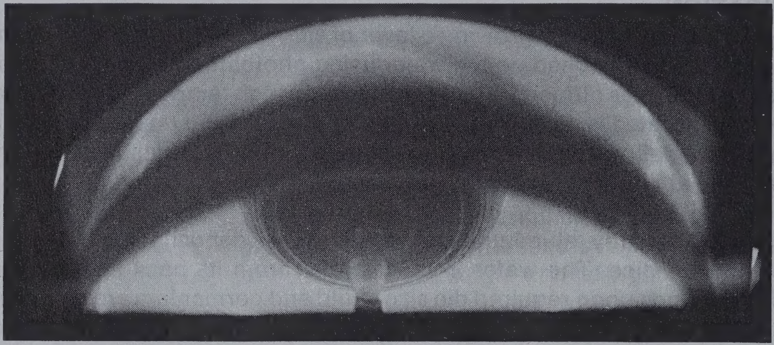
After further visual and electrical testing, lines are scribed between the dice on the wafer. This puts a fracture along the crystallographic planes so that a small strain breaks the wafer into individual dice. The dice are bonded onto headers, lead frames, or printed circuit boards to form a strong mechanical connection, as well as to make good electrical contact. Wires are bonded to the front-side metallization to make electrical contact between the device and the package leads. The device is then packaged by encapsulation, or by attaching a light pipe and lens to the lead frame or printed circuit board.

ENCAPSULATION MATERIALS

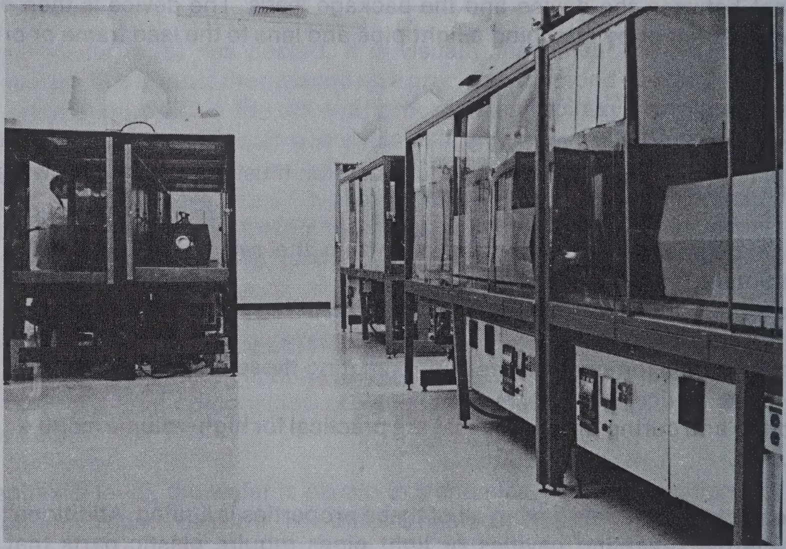
The plastic materials used in die encapsulation must exhibit the following properties:

A high degree of light transmission within the rated environmental conditions for the life of the device.
Good adherence of the material to the die, including protection of the die from moisture.
Thermal expansion coefficients approximating those of the other materials in the device.
Handling and curing properties that are practical for high-volume manufacturing.

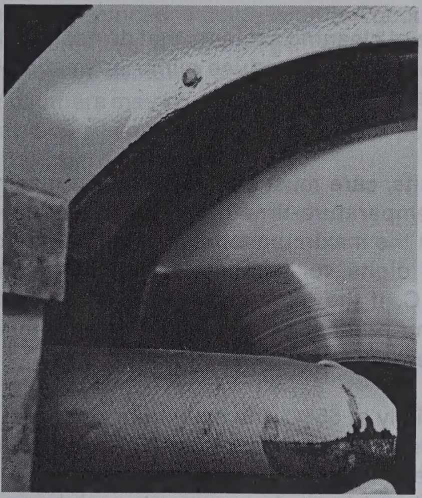
The choice of materials having all of these properties is limited. Additionally, digits that use internal reflecting cavities or light pipes require plastic parts that either have intrinsically high reflectance or are capalbe of being plated to obtain high reflectance. This further limits the choice of materials in those applications, and often precludes the use of fillers. These fillers, which are used in the epoxies and silicones added to the encapsulations of other electronic components, can tailor the expansion, viscocity, and adhesion properties of plastics to promote compatibility of the various piece parts and improve environmental ratings. Because of the limitations on the use of fillers, the maximum temperature rating for LED lamps is typically 100° C and for digits is typically 85° C. These temperatures are lower than those normally encountered in the soldering operation.



CZOCHRALSKI CRYSTAL GROWER

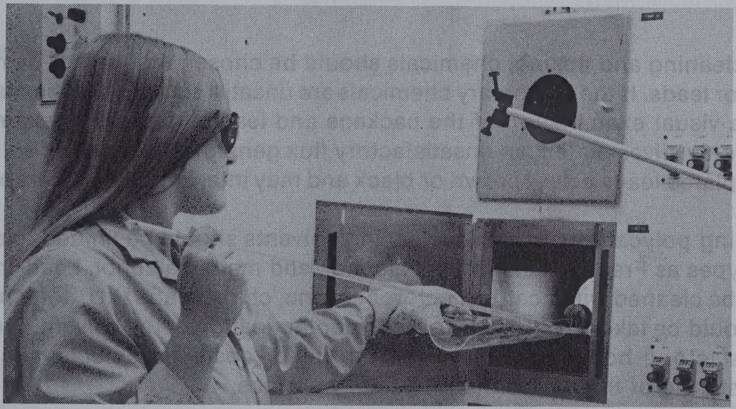


BRIDGMAN GaAs CRYSTAL GROWING ROOM



SLICING A GaAs INGOT WAFER

WAFER POLISHING



LOADING DIFFUSION FURNACE

Since material choice is so limited, the range of cleaning solvents that do not attack the lamp or digit is also reduced. Some popular solvents produce minor cosmetic blemishes, while others destroy the effective use of the device.

SOLDERING METHODS

When incorporating LED devices into circuits, care must be taken that the maximum temperature rating and maximum solder temperature-time rating are not exceeded. The latter specification is the point at which the maximum temperature internal to the device is reached, allowing in the case of digits, for example, a slightly increased ambient temperature of approximately 40° C. If the digit temperature exceeds 40° C prior to soldering, such as occurs with the preheat step sometimes used in wave soldering, a reduced soldering time is necessary.

For example, with the digit temperature initially at 55° C, the maximum soldering time would be about 2 1/2 seconds. Wave soldering conditions, in particular, vary widely, and the preheat temperature itself may exceed the digit maximum temperature rating. Elimination of preheating might be considered in such a case; at a minimum, the heating should be greatly reduced and soldering time minimized within acceptable soldering criteria. Alternative solutions are to place a thermal shield over the devices during the preheat stage, to use sockets or socket pins, or to change to hand soldering.

Stress on leads during soldering should also be considered. Bending of leads to hold devices in place is satisfactory, but care should be taken in bending the leads in printed circuit board holes to avoid high tensile forces. Over-heating during soldering could then weaken the device internally, possibly causing a board assembly or field failure.

CLEANING

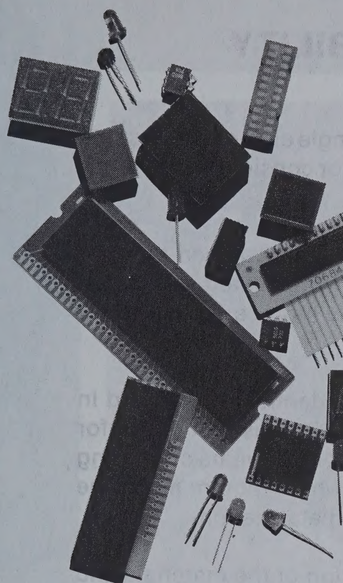
For pre-solder cleaning and fluxing, chemicals should be chosen that do not damage the device case or leads. If the customary chemicals are unsatisfactory, it will be readily apparent from a visual examination of the package and lead surfaces. For example, leads are commonly silver-plated; an unsatisfactory flux generally forms silver sulfide, which turns the plated leads a dark brown or black and may interfere with solderability.

For devices having polycarbonate cases, cleaning solvents should be limited to such non-corrosive types as Freon* TF, isopropyl alcohol, and methly alcohol. Lead-frame lamps may also be cleaned with acetone, chlorobenzene, chlorothane N.U., toluene, or xylene. Care should be taken in all cases to avoid contamination of the solvent. Freon* TE is also satisfactory; however, it may result in minor cosmetic defects, such as softening or blistering of the device back-fill epoxy surface.

*Trademark of E.I. duPont De Nemours Company

Another consideration, especially in the case of digits with air cavities, is the possibility of the solvent leaking into the package. The emitting die is enclosed in epoxy, so solvent within the digit should not present a reliability problem. Instead, the appearance of the digit may be affected, either in the off condition, the on condition, or both. The effect may be of a minor, acceptable nature.

A more pronounced leakage situation occurs when a heated digit is immersed in a cool solvent, creating a siphonage of solvent into the package. This leakage can be minimized by avoiding device immersion. Instead, for example, water, detergent, and other cleaners may be sprayed onto the bottom of the printed circuit board with the digit seating plane in a horizontal, downward position so that the solvents would tend to flow over the board surface.



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CHAPTER 2
DISCRETE LED DIGIT RELIABILITY

Display digits are typically used in groups, and the failure of a single element represents a failure of the entire display. Reliability must therefore be a major consideration in digit development and manufacture.

The design and production of Fairchild digits draws upon expertise gained through years of experience in high-volume production of plastic-encapsulated integrated circuits and optical products, for which a high level of reliability has been established.

DESIGN CONSIDERATIONS

The LED die used for each digit segment of decimal point is identical t that used in individual LED lamp products, so that extensive experience with design criteria for reliable performance is directly applicable. Also directly applicable are years of working with the metal contact systems of silicon integrated circuits, which require much the same level of ohmic contact and mechanical integrity as die metallization.

The inherent die reliability is preserved through careful selection of the materials and processes used to attach the die to the leadframe. The die and bonding wires, for example, are protected by complete encapsulation, and an encapsulated header allows the die and bonding wires to withstand mechanical and thermal stresses. The lens cap likewise has adequate dimensional tolerances to assure minimal machanical stress on the integral header lenses under environmenta stress conditions. The epoxy back-fill encapsulation used to attach the header and lens cap provide a good moisture seal.

All purchased materials for Fairchild digits are controlled through Optoelectronics Division product engineering, and through reliability and quality assurance (R&QA). Materials are purchased and inspected per control documents approved by R&QA; three methods are used to determine quality:

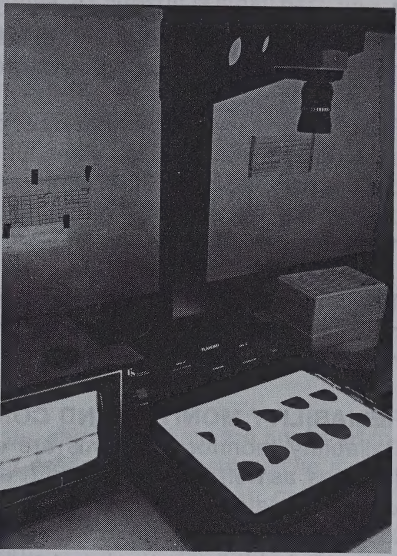
> Direct inspection per control documents, in which emphasis is placed on checking dimensions and physical properties of plastic piece parts and lead frames.
>
> Functional testing, in which tests are conducted to assure die attachment and bonding quality of the lead frames and dice.
>
> Chemical inspection, in which a scanning electron microscope (SEM) and an Auger electron spectroscope are used for detailed chemical analysis.

DEVICE TESTING

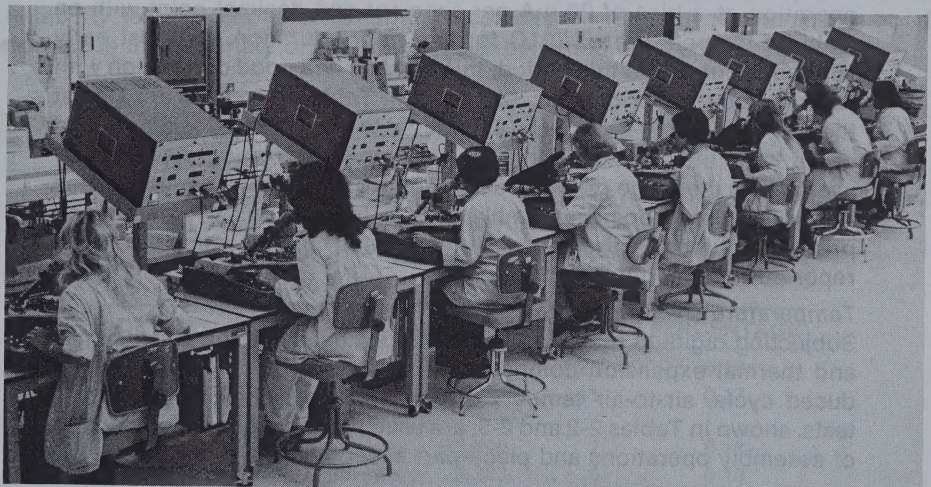
The following QA sample inspection levels are applied both before a digit batch is shipped and after 100% production testing to customer specifications:

Catastrophic (opens and shorts) - 0.25% AQL
Optoelectrical parameters - 1.0% AQL
Mechanical/visual light-up - 1.0% AQL
Mechanical/visual non-light-up - 1.5% AQL

WAFER INSPECTION



MEASURING WAFER FOR YIELD



RELIABILITY TESTING

Additionally, special customer requirements are accommodated through an internal specification system. All internal test specifications are verifed as satisfying customer requirements before being forwarded to the test area.

Fairchild provides digits that meet or exceed customer reliability requirements. However, reliability in the customer application is the final measure of performance. Besides digit design, assembly, and testing, therefore, digit end reliability is also affected by the customer's processes for handling the digit, the digit operating circuit, and the equipment that contains the digit.

The analysis of assembly and system failures by customers and by Fairchild on returned digits provides one of the most important inuputs to the Fairchild total reliability program.

RELIABILITY MONITOR AND CONTROL

Reliability monitor programs are established in each of Fairchild's manufacturing facilities, as well as at the reliability engineering facility. Functional testing is conducted under simulated environmental conditions, and accelerated stress testing is conducted to highlight any latent failure mechanisms. Several of these tests, described below, are part of Fairchild's continuing stress test program. The results presented typify those for the accelerated life test conditions applied in the tests and should not be used as an implied warranty of performance in any given application.

Burn-In

A high-temperature burn-in test has been conducted weekly with an average sample size of over 3000 digits per month. The test consists of operation at a bias of 20 mA per segment and decimal point with an ambient temperature of 70°C for two hours duration. As most early failures occur within this period, this test has had good correlation with failures in customer burn-in. As shown in Table 2-1, results are almost the same for longer-term tests. Compared to the indicated failure rate of about 1/4%, the customer-reported system burn-in failure rate generally averages in the range of 1/4%, to 1/2%, due to the various processes used in printed circuit board assembly. This is in addition to incoming and printed circuit board assembly failures, prior to burn-in, which have been reported to be about 0.4%.

Temperature Cycling and Shock

Subjecting digits to recurring thermal stres measures the dimensional and thermal expansion compatibility of internal parts. Results of reduced cycle, air-to-air temperature cycling tests and thermal-shock tests, shown in Tables 2-2 and 2-3, are used to assure continued control of assembly operations and piece-part acceptability.

Mechanical Shock

Another dimensional compatibility test used for assembly process and piece-part monitoring consists of a one-meter drop of digits in two axes in a test fixture. Significant failures quickly flag a problem for prompt action. Table 2-4 shows representative test results.

Gross Leak

Although back-fill epoxy encapsulation protects the digit from moisture, this encapsulation is not always totally effective. As a result, a small part of the production distribution will leak if immersed in fluid. This must be considered if, for example, thermal shock is likely to occur in a liquid bath or flux removal is accomplished in a bath. A weekly monitor measures the integrity of the back seal in a gross leak test. This test consists of preheating digits at 60° C and immersing them in Freon* TF for 30 seconds. This test functionally evaluates an assumed immersion cleaning technique. Accumulated test results are given in Table 2-5.

Solderability

Frequent solderability monitoring is conducted. This test criterion is 90% solder coverage in a 260° C, 5-second solder dip. Table 2-6 shows typical test results.

FAILURES MODES

Failures generated by the monitoring tests, life tests, and in the field are analyzed to identify needed corrective action in device design, assembly, or testing. The major failure mode has been found to be an open segment, which is often caused by excessive heating either during printed circuit board soldering or during operation when a bias exceeding the device ratings is applied.

COMPREHENSIVE TESTING

Several times a year, all digit types are evaluated in a series of comprehensive reliability tests, including extended temperature cycling, thermal shock, and operating life tests.

New LED digit types are qualified prior to introduction by an even more extensive series of reliability tests. Acceptance criteria are established for each test to assure good performance in the variety of environments expected in each application.

NOTE: The data in the following tables represents results obtained in recent history. LED digit reliability is expected to show the continued improvement evidenced in past data.

TABLE 2-1.
OPERATING MONITOR TEST RESULTS

I_F = 20 mA/Segment and Decimal Point

DEVICE	CONDITIONS	SAMPLE	FAILURES	PERCENTAGE
FND357	70° C, 2 hrs*	16,383	26	0.16
FND500/507	70° C, 2 hrs*	6,321	11	0.17
FND357	25° C, 100 hrs	1,090	2	0.18
FND500/507	25° C, 100 hrs	3,323	6	0.18

*Long term failure rates should not be based on these results since they are only a measure of infant mortality.

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*Trademark of E.I. duPont De Nemours Company

TABLE 2-2.
TEMPERATURE CYCLING MONITOR RESULTS

T_A = 25° C to +85° C, 2 Cycles

DEVICE TYPE	SAMPLE	FAILURES	PERCENTAGE
FND357	4,721	18	0.4
FND500/507	3,365	6	0.2

TABLE 2-3.
THERMAL SHOCK MONITOR RESULTS

T_A = 0 °C +85° C Water Baths, 15 Cycles

DEVICE TYPE	SAMPLE	FAILURES	PERCENTAGE
FND357	2,500	5	0.20
FND500/507	4,824	14	0.29
FND800/807	450	1	0.22

TABLE 2-4.
MECHANICAL SHOCK MONITOR RESULTS

One Meter Drop in Two Axes (Concrete Surface)

DEVICE TYPE	SAMPLE	FAILURES	PERCENTAGE
FND357	3,960	16	0.40
FND500/507	440	2	0.45

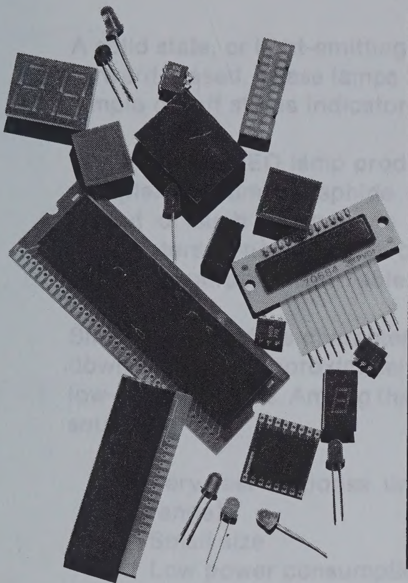
TABLE 2-5.
GROSS LEAK MONITOR RESULTS

60° C Bake, Immersion in 25° C Freon TF for 30 Seconds

DEVICE TYPE	SAMPLE	FAILURES	PERCENTAGE
FND357	2,199	47	2.1
FND500/507	3,296	80	2.4
FND800/807	1,900	11	0.6

TABLE 2-6.
SOLDERABILITY MONITOR RESULTS

DEVICE TYPE	SAMPLE	FAILURES	PERCENTAGE
FND357	1,600	1	0.1
FND500/507	2,300	5	0.2
FND800/807	1,050	0	0



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CHAPTER 3
INTRODUCTION

A solid state, or light-emitting diode (LED), lamp is a pn junction that emits light when forward-biased. These lamps have a multitude of uses, from complex array displays to simple on/off status indicators.

The Fairchild LED lamp products that emit light in the visible spectrum are made of complex gallium phosphide or gallium arsenide phosphide compounds. The light output of such compounds typically peaks at a wave-length of from 565 to 670 nanometers (nm); this peak can be varied by changing the exact composition for a particular purpose (see Table 31-).

Since these devices characteristically resemble a forward-biased diode with a break-down voltage of approximately 1. 6 V, they are ideal for use in all forms of low-voltage, low-power circuits. Among the other advantages solid state lamps have over other light sources are:

Very fast response times (rise and fall times in the submicrosecond range).
Small size
Low power consumption
Light weight
Long life (typically greater than 100,000 hours)
Low impedance (compatible with most semiconductor circuity)
Low heat generation

TABLE 3-1.
VISIBLE LED PERFORMANCE

LED TYPE	COLOR OF LIGHT	WAVELENGTH OF LIGHT (nm)	RELATIVE OPTICAL SENSITIVITY (LUMENS/ OPTICAL W)	EFFICIENCY (PERCENT)	VISUAL MERIT (LUMENS/ ELECTRICAL W)
GaAsP/GaAs	Red	670	20	0.1	0.02
GaAsP/GaAs	Red	660	40	0.03	0.012
GaAsP/GaP	Amber	635	140	0.14	0.2
GaAsP/GaP	Yellow	585	500	0.04	0.2
GaP/GaP	Green	565	590	0.05	0.30

COMMERICAL DEVICE PERFORMANCE

FAIRCHILD LED LAMP CROSS REFERENCE
KEY

COMPETITOR:

HP	Hewlett-Packard
MON	Monsanto
NAT	National Semiconductor
DIA	Dialight
TI	Texas Instruments
LIT	Litronix
XCT	Xciton

CODE:

NC-P	Not Crossable Because of Package Differences
NC-C	Not Crossable Because of Color Differences
NC-E	Not Crossable Because of Electrical Differences
A	Fairchild Device is a Direct Replacement
B	Fairchild Device is Easily Crossable with Minor Electrical Deviations as Noted
C	Fairchild Device is Easily Crossable with Minor Mechanical Deviations as Noted
D	Significant Electrical Differences Between Devices as Noted
E	Significant Mechanical Differences Between Devices as Noted

NOTES:

1	Fairchild Device is Screened for Intensity
2	Competitor Device is Point Source
3	Competitor Device has Pins Bent 90 Degrees
4	Competitor Device has .090" Pin Spacing
5	Competitor Device is Clear Diffused Package
6	Competitor Device is Water Clear Package
7	Package Height/Dimension Difference Between Devices
8	Pin Length Difference Between Devices
9	.025" Square Pins and .285" Lens on Competitor Device
10	Viewing Angle Difference Between Devices
11	Wavelength Difference Between Devices
12	.025" Square Pins with Standoffs on Competitor Device
13	Competitor Device is T-1 1/2 Lamp Size
14	Competitor Lamp is Flangeless Lamp
15	Competitor Lamp is Subminiature Sized with Radial Pins
16	Competitor Lamp has Metal Base
17	Fairchild Device is GaP Technology
18	Competitor Device has .075" Pin Spacing

FAIRCHILD LED CROSS REFERENCE

DEVICE	COMPETITOR	DESCRIPTION	FAIRCHILD DEVICE	CODE	NOTES
1N5765	HP	Hermetic LED Lamp, Red		NC-P	TO-46 pkg.
JANTX 1N5765	HP	Hermetic LED Lamp, Red		NC-P	TO-46 pkg.
JAN 1N5765	HP	Hermetic LED Lamp, Red		NC-P	TO-46 pkg.
5082-4100	HP	LED Lamp, Red		NC-P	15
5082-4101	HP	LED Lamp, Red		NC-P	15
5082-4150	HP	LED Lamp, Yellow		NC-P	15
5082-4160	HP	LED Lamp, Red		NC-P	15
5082-4190	HP	LED Lamp, Green		NC-P	15
5082-4403	HP	LED Lamp, Red	FLV160	C	8,16
5082-4415	HP	LED Lamp, Red	FLV160	E	3,16
5082-4420	HP	Hermetic LED Lamp, Red		NC-P	TO-46 pkg.
5082-4440	HP	LED Lamp, Red	FLV160	C	8,16
5082-4444	HP	LED Lamp, Red	FLV160	E	3,16
5082-4468	HP	LED Lamp, Red		NC-E	Resistor
5082-4480	HP	LED Lamp, Red	TIL209A	C	4,8
5082-4483	HP	LED Lamp, Red	TIL209A	E	4,5,8
5082-4484	HP	LED Lamp, Red	TIL209A	C	4,8
5082-4486	HP	LED Lamp, Red	TIL209A	E	4,6,8
5082-4487	HP	LED Lamp, Red	TIL209A	E	4,5,7,8
5082-4488	HP	LED Lamp, Red	TIL209A	E	4,5,7,8
5082-4494	HP	LED Lamp, Red	TIL209A	C	4,8
5082-4520	HP	Hermetic LED Lamp, Yellow		NC-P	TO-46 pkg.
5082-4550	HP	LED Lamp, Yellow	MV5353	C	8
5082-4555	HP	LED Lamp, Yellow	MV5353	C	8
5082-4557	HP	LED Lamp, Yellow	MV5354	C	8
5082-4558	HP	LED Lamp, Yellow	MV5354	B/C	1,8
5082-4570	HP	Rectangular LED, Yellow		NC-P	
5082-4584	HP	LED Lamp, Yellow	TIL213	C	4,8
5082-4590	HP	LED Lamp, Yellow	FLV440	C	8
5082-4592	HP	LED Lamp, Yellow	FLV440	B/C	1,8
5082-4595	HP	LED Lamp, Yellow	FLV441	C	8
5082-4597	HP	LED Lamp, Yellow	FLV441	B/C	1,8
5082-4620	HP	Hermetic LED Lamp, Red		NC-P	TO-46 pkg.
5082-4650	HP	LED Lamp, Red	MV5753	C	8
5082-4655	HP	LED Lamp, Red	MV5753	C	8
5082-4657	HP	LED Lamp, Red	MV5754	C	8
5082-4658	HP	LED Lamp, Red	MV5752	C	8
5082-4670	HP	Rectangular LED, Red		NC-P	
5082-4684	HP	LED Lamp, Red	TIL209A	B/C	4, Super GaAsP
5082-4690	HP	LED Lamp, Red	FLV540	C	8
5082-4693	HP	LED Lamp, Red	FLV540	B/C	1,8
5082-4694	HP	LED Lamp, Red	FLV540	E	2,8
5082-4695	HP	LED Lamp, Red	FLV540	E	2,8
5082-4707	HP	Mounting Clip	MP52	A	
5082-4732	HP	Voltage Sensing LED Lamp, Red		NC	
5082-4790	HP	LED Lamp, Red	FLV140	C	8
5082-4791	HP	LED Lamp, Red	FLV140	B/C	1,8
5082-4850	HP	LED Lamp, Red	MV5053	C	12
5082-4855	HP	LED Lamp, Red	MV5053	C	12
5082-4860	HP	LED Lamp, Red		NC-E	Resistor

FAIRCHILD LED CROSS REFERENCE

DEVICE	COMPETITOR	DESCRIPTION	FAIRCHILD DEVICE	CODE	NOTES
5082-4880	HP	LED Lamp, Red	MV5054-1	C	12,16
5082-4881	HP	LED Lamp, Red	MV5054-1	C	12,16
5082-4882	HP	LED Lamp, Red	MV5054-2	C	12,16
5082-4883	HP	LED Lamp, Red	MV5054-1	E	6,12,16
5082-4884	HP	LED Lamp, Red	MV5054-1	E	6,12,16
5082-4885	HP	LED Lamp, Red	MV5054-2	E	6,12,16
5082-4886	HP	LED Lamp, Red	MV5054-1	E	5,12,16
5082-4887	HP	LED Lamp, Red	MV5054-1	E	5,12,16
5082-4888	HP	LED Lamp, Red	MV5054-2	E	5,12,16
5082-4920	HP	LED Lamp, Green		NC-P	TO-46 pkg.
5082-4950	HP	LED Lamp, Green	MV5253	C	8
5082-4955	HP	LED Lamp, Green	MV5253	B/C	1,8
5082-4957	HP	LED Lamp, Green	MV5254	B/C	1,8
5082-4958	HP	LED Lamp, Green	MV5252	B/C	1,8
5082-4970	HP	Rectangular LED, Green		NC-P	
5082-4984	HP	LED Lamp, Green	TIL211	C	4
5082-4990	HP	LED Lamp, Green	FLV340	C	8
5082-4992	HP	LED Lamp, Green	FLV340	B/C	1,8
5082-4995	HP	LED Lamp, Green	FLV341	C	8
5082-4997	HP	LED Lamp, Green	FLV341	B/C	1,8
MV 10B	MON	LED Lamp, Red		NC-P	
MV 50	MON	LED Lamp, Red		NC-P	
MV 52	MON	LED Lamp, Green		NC-P	
MV 53	MON	LED Lamp, Green		NC-P	
MV 54	MON	LED Lamp, Red		NC-P	
MV 55	MON	LED Lamp, Red		NC-P	
MV 5020	MON	LED Lamp, Red	FLV161	E	6,10
MV 5021	MON	LED Lamp, Red	FLV160	E	5,10
MV 5022	MON	LED Lamp, Red	FLV161	C	10
MV 5023	MON	LED Lamp, Red	FLV160	C	10
MV 5024	MON	LED Lamp, Red	FLV160	C	10
MV 5025	MON	LED Lamp, Red	FLV160	C	10
MV 5026	MON	LED Lamp, Red	FLV160	C	10
MV 5050	MON	LED Lamp, Red	MV5050	A	8
MV 5051	MON	LED Lamp, Red	MV5051	A	8
MV 5052	MON	LED Lamp, Red	MV5052	A	8
MV 5053	MON	LED Lamp, Red	MV5053	A	8
MV 5054-1	MON	LED Lamp, Red	MV5054-1	A	8
MV 5054-2	MON	LED Lamp, Red	MV5054-2	A	8
MV 5054-3	MON	LED Lamp, Red	MV5054-3	A	8
MV 5055	MON	LED Lamp, Red	MV5055	A	8
MV 5056	MON	LED Lamp, Red	MV5056	A	8
MV 5074B	MON	LED Lamp, Red	TIL209A	C	8
MV 5074C	MON	LED Lamp, Red	TIL209A	C	8
MV 5075B	MON	LED Lamp, Red	TIL209A	C	8
MV 5075C	MON	LED Lamp, Red	TIL209A	C	8
MV 5077B	MON	LED Lamp, Red	TIL209A	E	7,8

FAIRCHILD LED CROSS REFERENCE

DEVICE	COMPETITOR	DESCRIPTION	FAIRCHILD DEVICE	CODE	NOTES
MV 5077C	MON	LED Lamp, Red	TIL209A	E	7,8
MV 5152	MON	LED Lamp, Orange	MV5152	A	8
MV 5153	MON	LED Lamp, Orange	MV5153	A	8
MV 5154	MON	LED Lamp, Orange	MV5154	A	8
MV 5252	MON	LED Lamp, Green	MV5252	A	8
MV 5253	MON	LED Lamp, Green	MV5253	A	8
MV 5254	MON	LED Lamp, Green	MV5254	A	8
MV 5352	MON	LED Lamp, Yellow	MV5352	A	8
MV 5353	MON	LED Lamp, Yellow	MV5353	A	8
MV 5354	MON	LED Lamp, Yellow	MV5354	A	8
MV 5752	MON	LED Lamp, Red	MV5752	A	8
MV 5753	MON	LED Lamp, Red	MV5753	A	8
MV 5754	MON	LED Lamp, Red	MV5754	A	8
MV 5174B	MON	LED Lamp, Orange		NC-P	
MV 5174C	MON	LED Lamp, Orange		NC-P	
MV 5177B	MON	LED Lamp, Orange		NC-P	
MV 5177C	MON	LED Lamp, Orange		NC-P	
MV 5274B	MON	LED Lamp, Green	TIL211	C	8
MV 5274C	MON	LED Lamp, Green	TIL211	C	8
MV 5277B	MON	LED Lamp, Green	TIL211	E	7,8
MV 5277C	MON	LED Lamp, Green	TIL211	E	7,8
MV 5374B	MON	LED Lamp, Yellow	TIL213	C	8
MV 5374C	MON	LED Lamp, Yellow	TIL213	C	8
MV 5377B	MON	LED Lamp, Yellow	TIL213	E	7,8
MV 5377C	MON	LED Lamp, Yellow	TIL213	E	7,8
MV 5774B	MON	LED Lamp, Red	TIL209A	B/C	8,11
MV 5774C	MON	LED Lamp, Red	TIL209A	B/C	8,11
MV 5777B	MON	LED Lamp, Red	TIL209A	D/E	1,7,8,11
MV 5777C	MON	LED Lamp, Red	TIL209A	D/E	1,7,8,11
MV 5094	MON	LED Lamp, Red/Green		NC-P	Bipolar
MV 5491	MON	LED Lamp, Red/Green		NC-P/E	Tri-state
MP 21	MON	Mounting Hardware, Clear		NC-P	
MP 22	MON	Mounting Hardware, Black		NC-P	
MP 51	MON	Mounting Hardware, Clear	MP52	E	Clear
MP 52	MON	Mounting Hardware, Black	MP52	A	
NSL 4944	NAT	LED Lamp, Red		NC-E	
NSL 5072A	NAT	LED Lamp, Red	TIL209A	E	2,7
NSL 5076A	NAT	LED Lamp, Red	TIL209A	A	
NSL 5020	NAT	LED Lamp, Red	FLV161	E	6,12,13
NSL 5022	NAT	LED Lamp, Red	FLV161	E	13
NSL 5023	NAT	LED Lamp, Red	FLV160	E	13
NSL 5024	NAT	LED Lamp, Red	FLV160	E	13
NSL 5026	NAT	LED Lamp, Red	FLV160	E	13
NSL 5027	NAT	LED Lamp, Red	FLV160	B/E	1,13
NSL 5040	NAT	LED Lamp, Red	FLV141	E	6,7,14
NSL 5041	NAT	LED Lamp, Red	FLV140	E	5,7,14
NSL 5042	NAT	LED Lamp, Red	FLV141	C	7,14

FAIRCHILD LED CROSS REFERENCE

DEVICE	COMPETITOR	DESCRIPTION	FAIRCHILD DEVICE	CODE	NOTES
NSL 5043	NAT	LED Lamp, Red	FLV140	C	7,14
NSL 5046	NAT	LED Lamp, Red	FLV140	C	7,14
NSL 5050	NAT	LED Lamp, Red	MV5050	C	12
NSL 5052	NAT	LED Lamp, Red	MV5052	C	12
NSL 5053	NAT	LED Lamp, Red	MV5053	C	12
NSL 5056	NAT	LED Lamp, Red	MV5053	C	12
NSL 5057	NAT	LED Lamp, Red		NC-P	
NSL 5080	NAT	LED Lamp, Red	TIL209A	E	6
NSL 5081	NAT	LED Lamp, Red	TIL209A	E	1,5
NSL 5082	NAT	LED Lamp, Red	TIL209A	E	2
NSL 5086	NAT	LED Lamp, Red	TIL209A	B	1
NSL 5252	NAT	LED Lamp, Green	MV5252	C	8
NSL 5253	NAT	LED Lamp, Green	MV5253	C	8
NSL 5352	NAT	LED Lamp, Green	MV5253	C	8
NSL 5353	NAT	LED Lamp, Green	MV5353	C	8
249-SERIES	DIA	Mini LED Indicator Lights		NC-P	
521-9165	DIA	LED Lamp, Red	FLV110	A	
521-9166	DIA	LED Lamp, Red	FLV112	A	
521-9178	DIA	LED Lamp, Red	FLV160	A	
521-9179	DIA	LED Lamp, Red	FLV160	C	7
521-9180	DIA	LED Lamp, Red	FLV130	A	
521-9181	DIA	LED Lamp, Red		NC-P	
521-9183	DIA	LED Lamp, Red		NC-E	Resistor
521-9184	DIA	LED Lamp, Red		NC-E	Resistor
521-9185	DIA	LED Lamp, Red		NC-P	
521-9186	DIA	LED Lamp, Red		NC-P	
521-9189	DIA	LED Lamp, Red	TIL209A	A	
521-9190	DIA	LED Lamp, Red	FLV111	A	
521-9195	DIA	LED Lamp, Red		NC-P	
521-9200	DIA	LED Lamp, Red	FLV117	A	
521-9201	DIA	LED Lamp, Green		NC-P	
521-9202	DIA	LED Lamp, Green	FLV310	E	2,12
521-9203	DIA	LED Lamp, Green	FLV310	C	12
521-9204	DIA	LED Lamp, Yellow	FLV410	E	2,12
521-9205	DIA	LED Lamp, Yellow	FLV410	C	12
521-9206	DIA	LED Lamp, Green	TIL211	A	
521-9207	DIA	LED Lamp, Yellow	TIL213	A	
521-9208	DIA	LED Lamp, Yellow		NC-P	
521-9214	DIA	LED Lamp, Red	FLV117	E	3
521-9215	DIA	LED Lamp, Red		NC-P	Resistor
521-9216	DIA	LED Lamp, Red	TIL209A	E	4,7
521-9217	DIA	LED Lamp, Red	MV5053	A	
521-9222	DIA	LED Lamp, Red		NC-P	
521-9223	DIA	LED Lamp, Red		NC-P	
521-9230	DIA	LED Lamp, Red	FLV131	A	
521-9253	DIA	LED Lamp, Green	FLV311	A	
521-9254	DIA	LED Lamp, Yellow	FLV411	A	
547-SERIES	DIA	LED Logic Indicators		NC-P	

FAIRCHILD LED CROSS REFERENCE

DEVICE	COMPETITOR	DESCRIPTION	FAIRCHILD DEVICE	CODE	NOTES
549-0101	DIA	LED Lamp, Red		NC-P	
549-0104	DIA	LED Lamp, Red		NC-P	
550-SERIES	DIA	LED Logic Indicators		NC-P	
555-SERIES	DIA	LED Logic Indicators		NC-P	
558-SERIES	DIA	LED Indicators		NC-P	
559-SERIES	DIA	LED Indicators		NC-P	
507-SERIES	DIA	LED Lamp Cartridges		NC-P	
TIL 209A	TI	LED Lamp, Red	TIL209A	A	
TIL 211	TI	LED Lamp, Green	TIL211	A	
TIL 220	TI	LED Lamp, Red	MV5053	C	8,12
TIL 221	TI	LED Lamp, Red	MV5050	C	8,12
TIL 222	TI	LED Lamp, Green	MV5253	C	8,12
TIL 261	TI	LED Light Sources, Red		NC-P	
TIL 262	TI	LED Light Sources, Red		NC-P	
TIL 263	TI	LED Light Sources, Red		NC-P	
TIL 264	TI	LED Light Sources, Red		NC-P	
TIL 265	TI	LED Light Sources, Red		NC-P	
TIL 266	TI	LED Light Sources, Red		NC-P	
TIL 267	TI	LED Light Sources, Red		NC-P	
TIL 268	TI	LED Light Sources, Red		NC-P	
TIL 269	TI	LED Light Sources, Red		NC-P	
TIL 270	TI	LED Light Sources, Red		NC-P	
TIL 271	TI	LED Light Sources, Green		NC-P	
TIL 272	TI	LED Light Sources, Green		NC-P	
TIL 273	TI	LED Light Sources, Green		NC-P	
TIL 274	TI	LED Light Sources, Green		NC-P	
TIL 275	TI	LED Light Sources, Green		NC-P	
TIL 276	TI	LED Light Sources, Green		NC-P	
TIL 277	TI	LED Light Sources, Green		NC-P	
TIL 278	TI	LED Light Sources, Green		NC-P	
TIL 279	TI	LED Light Sources, Green		NC-P	
TIL 280	TI	LED Light Sources, Green		NC-P	
TIL 281	TI	LED Light Sources, Amber		NC-P	
TIL 282	TI	LED Light Sources, Amber		NC-P	
TIL 283	TI	LED Light Sources, Amber		NC-P	
TIL 284	TI	LED Light Sources, Amber		NC-P	
TIL 285	TI	LED Light Sources, Amber		NC-P	
TIL 286	TI	LED Light Sources, Amber		NC-P	
TIL 287	TI	LED Light Sources, Amber		NC-P	
TIL 288	TI	LED Light Sources, Amber		NC-P	
TIL 289	TI	LED Light Sources, Amber		NC-P	
TIL 290	TI	LED Light Sources, Amber		NC-P	
RL 2	LIT	LED Lamp, Red	FLV110	A	
RL 2-02	LIT	LED Lamp, Red	FLV251	B	17
RL 2-03	LIT	LED Lamp, Red	FLV112	A	
RL 2-04	LIT	LED Lamp, Red	FLV111	A	
RL 20	LIT	LED Lamp, Red	MV5054-1	A	

FAIRCHILD LED CROSS REFERENCE

DEVICE	COMPETITOR	DESCRIPTION	FAIRCHILD DEVICE	CODE	NOTES
RL 21	LIT	LED Lamp, Red	MV5053	C	8,12
RL 50	LIT	LED Lamp, Red		NC-P	
RL 50-01	LIT	LED Lamp, Red		NC-P	
RL 50-02	LIT	LED Lamp, Red		NC-P	
RL 50-03	LIT	LED Lamp, Red		NC-P	
RL 54	LIT	LED Lamp, Red		NC-P	
RL 55	LIT	LED Lamp, Red		NC-P	
RL 55-5	LIT	LED Lamp, Red		NC-P	
YL 56	LIT	LED Lamp, Yellow		NC-P	
GL 56	LIT	LED Lamp, Green		NC-P	
RL 209	LIT	LED Lamp, Red	TIL209A	C	8,18
RL T-1	LIT	LED Lamp, Red	TIL209A	E	8,14,18
RL 209-02	LIT	LED Lamp, Red	TIL209A	E	2,8,18
RL 209-03	LIT	LED Lamp, Red	TIL209A	E	5,8,18
RL 209-04	LIT	LED Lamp, Red	TIL209A	E	6,8,18
RL T1-02	LIT	LED Lamp, Red	TIL209A	E	2,8,14,18
RL T1-03	LIT	LED Lamp, Red	TIL209A	E	5,8,14,18
RL T1-04	LIT	LED Lamp, Red	TIL209A	E	6,8,14,18
RL 2000	LIT	LED Lamp, Red	MV5054-2	C	8,12
RL 4403	LIT	LED Lamp, Red	MV5053	C	8,12
RL 4415	LIT	LED Lamp, Red	MV5053	E	3,8,12
GL 4484	LIT	LED Lamp, Green	TIL211	C	8,18
YL 4484	LIT	LED Lamp, Yellow	TIL213	C	8,18
RL 4484	LIT	LED Lamp, Red	TIL209A	C	8,18
GL 4850	LIT	LED Lamp, Green	MV5253	C	8
YL 4850	LIT	LED Lamp, Yellow	MV5353	C	8
RL 4850	LIT	LED Lamp, Red	MV5053	C	8,12
RL 5054-1	LIT	LED Lamp, Red	MV5054-1	C	8,12
RL 5054-2	LIT	LED Lamp, Red	MV5054-2	C	8,12
RL C200	LIT	LED Lamp, Red		NC-E	
RL C201	LIT	LED Lamp, Red		NC-E	
RL C210	LIT	LED Lamp, Red		NC-E	
RL C410	LIT	LED Lamp, Red		NC-E	
OL 30	LIT	LED Lamp, Orange		NC-E	
XC 212	XCT	LED Lamp, Red		NC-P	T 3/4
XC 212G	XCT	LED Lamp, Green		NC-P	T 3/4
XC 212Y	XCT	LED Lamp, Yellow		NC-P	T 3/4
XC 212A	XCT	LED Lamp, Amber		NC-P	T 3/4
XC 209	XCT	LED Lamp, Red	TIL209A	A	
XC 209G	XCT	LED Lamp, Geen	TIL211	A	
XC 209Y	XCT	LED Lamp, Yellow	TIL 213	A	
XC 209A	XCT	LED Lamp, Amber		NC-C	
XC 209-02	XCT	LED Lamp, Red	TIL209A	E	2
XC 209G-02	XCT	LED Lamp, Green	TIL211	E	2
XC 209Y-02	XCT	LED Lamp, Yellow	TIL213	E	2
XC 209A-02	XCT	LED Lamp, Amber		NC-C	
XC 209-03	XCT	LED Lamp, Red	TIL209A	E	5
XC 209G-03	XCT	LED Lamp, Green	TIL211	E	5

FAIRCHILD LED CROSS REFERENCE

DEVICE	COMPETITOR	DESCRIPTION	FAIRCHILD DEVICE	CODE	NOTES
XC 209Y-03	XCT	LED Lamp, Yellow	TIL213	E	5
XC 209-04	XCT	LED Lamp, Red	TIL209A	E	6
XC 209G-04	XCT	LED Lamp, Green	TIL211	E	6
XC 209Y-04	XCT	LED Lamp, Yellow	TIL213	E	6
XC 520	XCT	LED Lamp, Red	FLV161	E	6,7,8
XC 521	XCT	LED Lamp, Red	FLV160	E	5,7,8
XC 521G	XCT	LED Lamp, Green	FLV360	E	5,7,8
XC 521Y	XCT	LED Lamp, Yellow	FLV460	E	5,7,8
XC 522	XCT	LED Lamp, Red	FLV161	C	7,8
XC 522G	XCT	LED Lamp, Green	FLV361	C	7,8
XC 522Y	XCT	LED Lamp, Yellow	FLV461	C	7,8
XC 522A	XCT	LED Lamp, Amber		NC-C	
XC 524	XCT	LED Lamp, Red	FLV161	E	1,7,8,10
XC 524G	XCT	LED Lamp, Green	FLV361	E	1,7,8,10
XC 524Y	XCT	LED Lamp, Yellow	FLV461	E	1,7,8,10
XC 524A	XCT	LED Lamp, Amber		NC-C	
XC 526	XCT	LED Lamp, Red	FLV160	C	7,8
XC 526G	XCT	LED Lamp, Green	FLV360	C	7,8
XC 526Y	XCT	LED Lamp, Yellow	FLV460	C	7,8
XC 526A	XCT	LED Lamp, Amber		NC-C	
XC 526-2	XCT	LED Lamp, Red	FLV560	C	7,8
XC 526G-2	XCT	LED Lamp, Green	FLV360	B/C	1,7,8
XC 526Y-2	XCT	LED Lamp, Yellow	FLV460	B/C	1,7,8
XC 526A-2	XCT	LED Lamp, Amber		NC-C	
XC 5025	XCT	LED Lamp, Red	FLV160	E	7,8,10
XC 5025G	XCT	LED Lamp, Green	FLV360	E	7,8,10
XC 5025Y	XCT	LED Lamp, Yellow	FLV460	E	7,8,10
XC 5025A	XCT	LED Lamp, Amber		NC-C	
XC 110	XCT	LED Lamp, Red	FLV110	C	8
XC 110G	XCT	LED Lamp, Green	FLV310	C	8
XC 110Y	XCT	LED Lamp, Yellow	FLV410	C	8
XC 110A	XCT	LED Lamp, Amber		NC-C	
XC 111	XCT	LED Lamp, Red	FLV111	C	8
XC 111G	XCT	LED Lamp, Green		NC-P	2
XC 111Y	XCT	LED Lamp, Yellow		NC-P	2
XC 111A	XCT	LED Lamp, Amber		NC-C	
XC 112	XCT	LED Lamp, Red	FLV112	C	8
XC 112G	XCT	LED Lamp, Green		NC-P	5
XC 112Y	XCT	LED Lamp, Yellow		NC-P	5
XC 554-3	XCT	LED Lamp, Red	MV5752	C	8,12
XC 554G-2	XCT	LED Lamp, Green	MV5252	C	8,12
XC 554Y-2	XCT	LED Lamp, Yellow	MV5352	C	8,12
XC 554A-2	XCT	LED Lamp, Amber		NC-C	
XC 554-6	XCT	LED Lamp, Red	MV5752	C	8,12
XC 554G-4	XCT	LED Lamp, Green	MV5252	C	8,12
XC 554Y-4	XCT	LED Lamp, Yellow	MV5352	C	8,12
XC 554A-4	XCT	LED Lamp, Amber		NC-C	
XC 554-9	XCT	LED Lamp, Red	MV5752	B/C	1,8,12
XC 554G-6	XCT	LED Lamp, Green	MV5252	B/C	1,8,12

FAIRCHILD LED CROSS REFERENCE

DEVICE	COMPETITOR	DESCRIPTION	FAIRCHILD DEVICE	CODE	NOTES
XC 554Y-6	XCT	LED Lamp, Yellow	MV5352	B/C	1,8,12
XC 554A-6	XCT	LED Lamp, Amber		NC-C	
XC 556	XCT	LED Lamp, Red	MV5054-1	C	8,12
XC 556G	XCT	LED Lamp, Green	MV5253	C	8,12
XC 556Y	XCT	LED Lamp, Yellow	MV5353	C	8,12
XC 556A	XCT	LED Lamp, Amber		NC-C	
XC 556-2	XCT	LED Lamp, Red	MV5054-2	C	8,12
XC 556G-2	XCT	LED Lamp, Green	MV5253	B/C	1,8,12
XC 556Y-2	XCT	LED Lamp, Yellow	MV5353	B/C	1,8,12
XC 556A-2	XCT	LED Lamp, Amber		NC-C	
XC 556-3	XCT	LED Lamp, Red	MV5054-3	C	8,12
XC 5053	XCT	LED Lamp, Red	MV5053	C	8,12
XC 5053G	XCT	LED Lamp, Green	MV5253	E	8,10,12
XC 5053Y	XCT	LED Lamp, Yellow	MV5353	E	8,10,12
XC 5053A	XCT	LED Lamp, Amber		NC-C	
XC 5055	XCT	LED Lamp, Red	MV5053	E	8,10,12
XC 5055G	XCT	LED Lamp, Green	MV5053	E	8,10,12
XC 5055Y	XCT	LED Lamp, Yellow	MV5353	E	8,10,12
XC 21	XCT	LED Lamp, Red	FLV141	E	7,8,12
XC 21G	XCT	LED Lamp, Green	FLV341	E	7,8,12
XC 21Y	XCT	LED Lamp, Yellow	FLV441	E	7,8,12
XC 21A	XCT	LED Lamp, Amber		NC-C	
XC 22	XCT	LED Lamp, Red	FLV140	E	7,8,12
XC 22G	XCT	LED Lamp, Green	FLV340	E	7,8,12
XC 22Y	XCT	LED Lamp, Yellow	FLV440	E	7,8,12
XC 22A	XCT	LED Lamp, Amber		NC-C	
XC 22-2	XCT	LED Lamp, Red	FLV540	E	7,8,11,12
XC 22G-2	XCT	LED Lamp, Green	FLV340	E	7,8,12
XC 25	XCT	LED Lamp, Red	FLV140	E	7,8,10,12
XC 25G	XCT	LED Lamp, Green	FLV340	E	7,8,10,12
XC 25Y	XCT	LED Lamp, Yellow	FLV440	E	7,8,10,12
XC 25A	XCT	LED Lamp, Amber		NC-C	
XC 22-5V	XCT	LED Lamp, Red		NC-P	Resistor
XC 22-5VA	XCT	LED Lamp, Amber		NC-P	Resistor
XC 22-5VG	XCT	LED Lamp, Green		NC-P	Resistor
XC 22-5VY	XCT	LED Lamp, Yellow		NC-P	Resistor
XC 209-5V	XCT	LED Lamp, Red		NC-P	Resistor
XC 209-5VG	XCT	LED Lamp, Green		NC-P	Resistor
XC 209-5VY	XCT	LED Lamp, Yellow		NC-P	Resistor
XC 5053-5V	XCT	LED Lamp, Red		NC-P	Resistor
XC 5053-5VA	XCT	LED Lamp, Amber		NC-P	Resistor
XC 5053-5VG	XCT	LED Lamp, Green		NC-P	Resistor
XC 5053-5VY	XCT	LED Lamp, Yellow		NC-P	Resistor

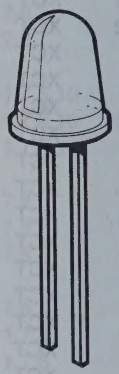
FLV104A

NARROW BEAM GaAsP LAMP

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION — The FLV104A narrow beam visible lamp is a high intensity source specifically intended for excitation of photosensors, especially photo-diodes and transistors, when the separation distances are measured from mm to several meters.

The FLV104A is the visible beam companion device to the FPE104 infrared LED. Both devices have identical optics and therefore identical radiation patterns.



- **VERY HIGH AXIAL INTENSITY**
- **NARROW BEAMWIDTH**
- **DETECTABLE AT 30 FEET**

ABSOLUTE MAXIMUM RATINGS

Maximum Temperatures and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +125°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	98 %

Maximum Power Dissipation

Total Dissipation at T_A = 25°C	200 mW
Derate Linearly from T_A = 25°C	2.6 mW/°C

Maximum Voltages and Currents

V_R	Reverse Voltage	3.0 V
I_F	Forward Current	1.0 A
i_f	Peak Forward Current (100 μs pulsewidth 1% duty cycle)	100 mA

ELECTRICAL CHARACTERISTICS: T_A = 25°C

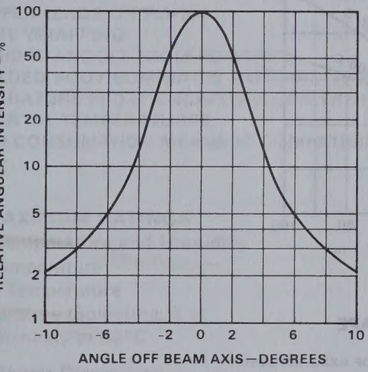
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST COND.
V_F	Forward Voltage		2.0	2.5	Volts	I_F = 100 mA
BV_R	Reverse Breakdown Voltage	3.0	8.0		Volts	I_R = 10 μA

OPTOELECTRONIC CHARACTERISTICS : I_F = 100 mA, T_A = 25°C

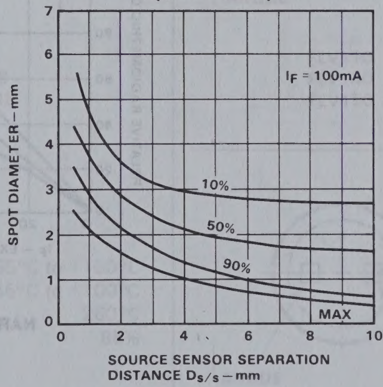
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS
I_L	Axial Luminous Intensity	50	150		mcd
I	Axial Radiometric Intensity		4.0		mw/sr
L	Average Effective Luminence		5.0		cd/cm²
N	Average Effective Radiance (Axial)		140		mw/sr/cm²
A_S	Effective Emitting Source Area (Axial)		.028		cm²
$\Delta I/\Delta T$	Temperature Coefficient of Intensity (Note 1)		0.5		%/°C
$\Delta I \Delta I_F$	Excitation Coefficient of Intensity (Note 1)		1.0		%/°C
λpk	Peak Spectral Wavelength		670		nm
$\Delta\lambda$	Spectral Bandwidth		20		nm
$\Delta\lambda pk/\Delta T$	Temperature Spectral Shift Coefficient (Note 2)		0.17		nm/°C
$\Delta\lambda pk/\Delta T_F$	Excitation Spectral Shift Coefficient (Note 2)		0.1		nm/mA
$\theta 50$	Beam Angle at 50% Axial Intensity		4.3		Degrees
$\Delta\theta_A$	Beam Axis to Mechanical Axis		1.5		Degrees
t_r and t_f	Light Output Rise and Fall Time (Note 3)		10		ns
c_o	Capacitance (V=0,f=1.0 MHz)		100		pF

TYPICAL CHARACTERISTIC CURVES

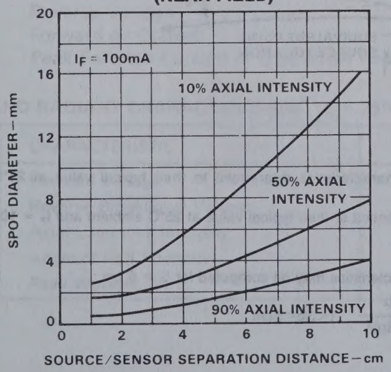
BEAM PATTERN OF INTENSITY



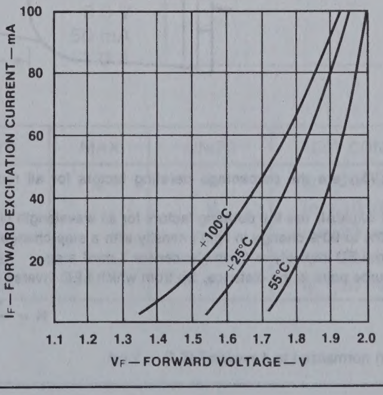
SPOT DIAMETER VERSUS SEPARATION DISTANCE (NEAR FIELD)



SPOT DIAMETER VERSUS SEPARATION DISTANCE (NEAR FIELD)

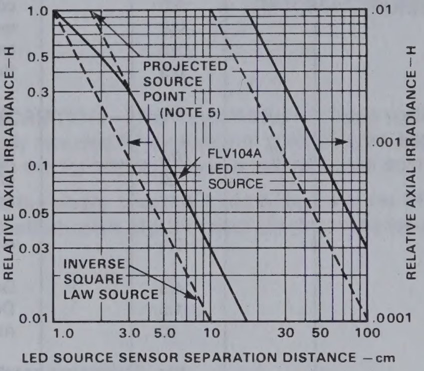


FORWARD V-I CHARACTERISTICS

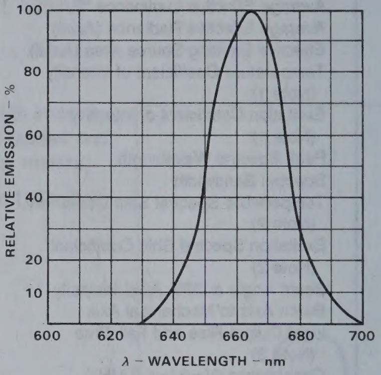


TYPICAL CHARACTERISTIC CURVES (Cont'd)

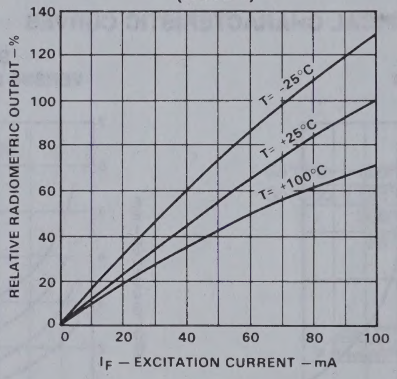
AVERAGE AXIAL IRRADIANCE, H (NOTE 6)



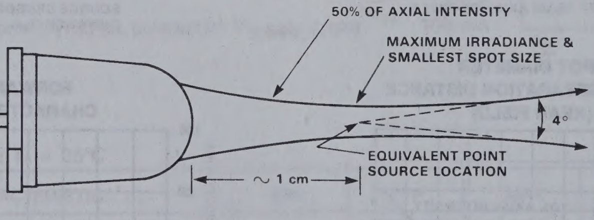
EMISSION SPECTRUM



RELATIVE RADIOMETRIC OUTPUT (NOTE 4)



NARROW BEAM SHAPE


50% OF AXIAL INTENSITY
MAXIMUM IRRADIANCE & SMALLEST SPOT SIZE
4°
EQUIVALENT POINT SOURCE LOCATION
~ 1 cm

NOTES:

1. $\Delta I/\Delta T$ and $\Delta I/\Delta I_F$ are the percentage derating factors for all radiometric output characteristics referenced to their typical value at 25°C ambient and $I_F = 100$ mA.
2. $\Delta\lambda pk/\Delta T$ and $\Delta\lambda pk/\Delta I_F$ are the derating factors for all wavelength characteristics referenced to their typical value at 25°C ambient and $I_F = 100$ mA.
3. Time for a 10% to 90% change in light intensity with a step change in current.
4. Normalization: LED intensity ≃ 10 mw/sr sensor 1 mm² area.
5. Projected source point is the distance, Sp from which LED inverse square LAW characteristics may be computed for S ⩾ 5 cm.

$$H = \frac{1.0\ \text{mw}}{\text{cm}^2} \times \frac{Sp^2}{(S-Sp)^2}, \quad 1<Sp<S\text{cm}$$

6. Irradiance (H) normalized to 4 mw/cm² @ S = 1 cm.

FLV110 • FLV140 • FLV150 • FLV160

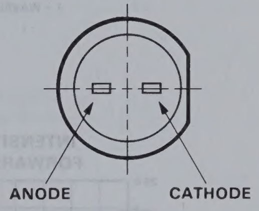
RED GaAsP LED LAMPS

OPTOELECTRONICS PRODUCT GROUP

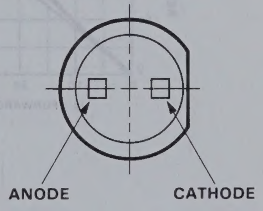
GENERAL DESCRIPTION — The FLV110, FLV140, FLV150 and FLV160 are red light emitting diodes encapsulated in diffused plastic. These LED devices provide an intense large area light source with wide angle viewing. Visual light emission is in the 600 nm to 700 nm range.

- SOLID STATE THUS NO REPLACEMENT REQUIRED
- NO SOCKET REQUIRED
- HIGH ON/OFF CONTRAST
- FLEXIBLE PINS ON FLV110, FLV140 AND FLV150
  FOR GOOD HEAT SINKING
  FOR RIGHT ANGLE BENDING
  FITS STANDARD SOCKETS AND DRILLED HOLES
- HEAVY COPPER LEADS ON FLV160
  FOR WIRE WRAPPING
  FOR RIGID STANDOFF FROM PC BOARD
- SINGLE MOLDED BODY ELIMINATES THERMAL CYCLING PROBLEMS
- HIGH TEMPERATURE EPOXY ENCAPUSLATION WITHSTANDS SEVERE ENVIRONMENTAL TEMPERATURES
- LOW POWER CONSUMPTION MEANS IC COMPATIBILITY

PIN CONNECTIONS



FLV110
FLV140
FLV150



FLV160

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

Maximum Power Dissipation

Total Dissipation at T_A = 25°C	120 mW
Derate Linearly from 25°C	1.6 mW/°C

Maximum Voltage and Currents

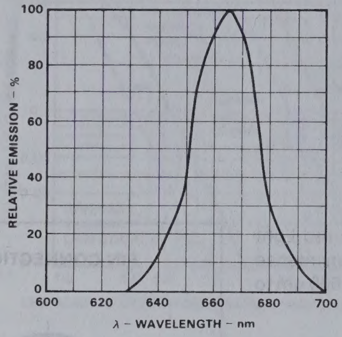
V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	50 mA
i_f	Peak Forward Current (1.0 μs pulse width)	1.0 A

ELECTRICAL AND RADIANT CHARACTERISTICS: T_A = 25°C

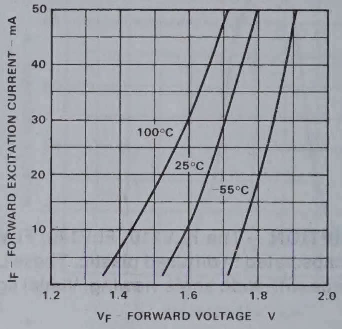
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.7	2.0	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	3.0	8.0		V	$I_R = 10\ \mu A$
I_O	Axial Luminous Intensity	0.8	2.0		mcd	$I_F = 20$ mA
$\theta_{1/2}$	Angle of Half Intensity		±35		degrees	$I_F = 20$ mA
λ_{pk}	Peak Wavelength		665		nm	$I_F = 20$ mA

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

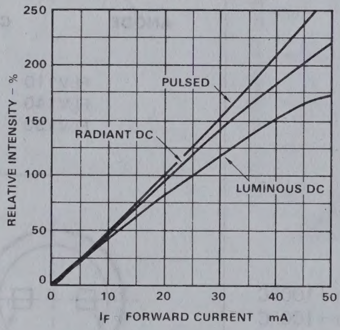
EMISSION SPECTRUM



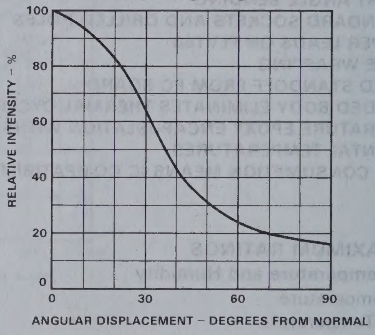
FORWARD CURRENT VERSUS FORWARD VOLTAGE



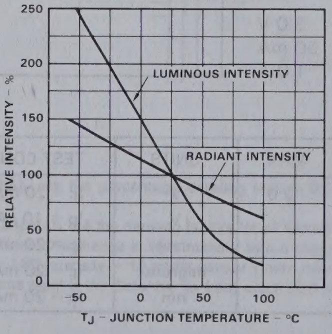
INTENSITY VERSUS FORWARD CURRENT



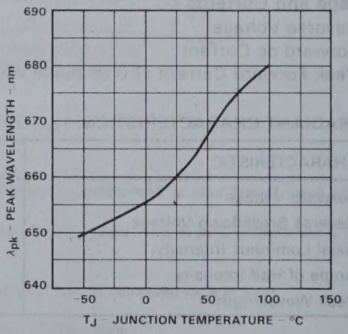
INTENSITY VERSUS VIEWING ANGLE



INTENSITY VERSUS TEMPERATURE



PEAK WAVELENGTH VERSUS TEMPERATURE



FLV111 • FLV112 • FLV117 • FLV118

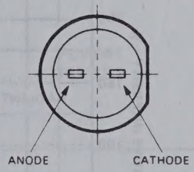
RED GaAsP LED LAMPS

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION — The FLV111 is a water clear version of the FLV110. The FLV112 is a diffused lens in clear (non-red) epoxy. FLV117 is a low-cost lamp encapsulated in diffused red epoxy. The FLV118 is a water clear version of the FLV117. Visual light emission is in the 600-700 nm range.

- **SOLID STATE — NO REPLACEMENT REQUIRED**
- **NO SOCKET REQUIRED**
- **HIGH ON/OFF CONTRAST**
- **FLEXIBLE PINS FOR GOOD HEAT SINKING AND RIGHT ANGLE BENDING**
- **FITS STANDARD SOCKETS AND DRILLED HOLES**
- **SINGLE MOLDED BODY ELIMINATES THERMAL CYCLING PROBLEMS**
- **HIGH TEMPERATURE EPOXY ENCAPSULATION WITHSTANDS SEVERE ENVIRONMENTAL TEMPERATURES**
- **LOW POWER CONSUMPTION MEANS IC COMPATIBILITY**

PIN CONNECTIONS



ABSOLUTE MAXIMUM RATINGS

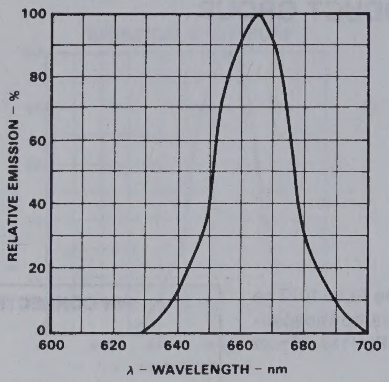
Maximum Temperature and Humidity	
Storage Temperature	-55° C to +150° C
Junction Temperature	125° C
Pin Temperature (Soldering, 5 s)	260° C
Relative Humidity at 85° C	85%
Maximum Power Dissipation	
Total Dissipation	100 mW
Derate Linearly from 100° C	4.0 mW/° C
Maximum Voltage and Currents	
V_R Reverse Voltage	3.0 V
I_F Forward dc Current	50 mA
I_{pk} Forward Peak Current (1.0 μs pulse)	1.0 A

ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

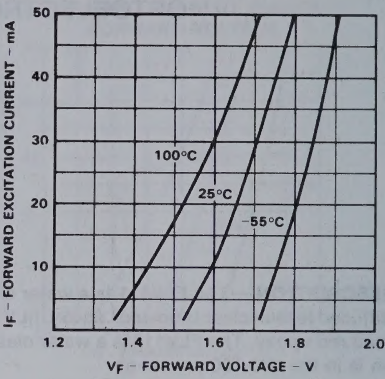
SYMBOL	CHARACTERISTICS	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.7	3.0	V	$I_F = 20$ mA
BV_R	Reverse Voltage		8.0		V	$I_R = 10\ \mu A$
I_O	Axial Luminous Intensity					
	FLV111, FLV112	0.8	2.0		mcd	$I_F = 20$ mA
	FLV117, FLV118					
$\theta_{1/2}$	Angle of Half Intensity					
	FLV111, FLV112		±35		degrees	$I_F = 20$ mA
	FLV117, FLV118		±20			
λ_{pk}	Peak Wavelength		665		nm	$I_F = 20$ mA

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

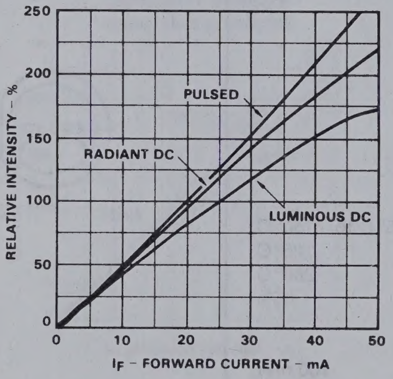
EMISSION SPECTRUM



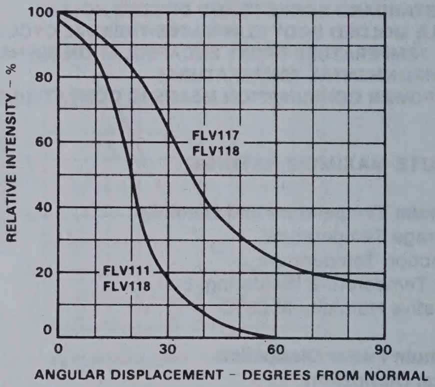
FORWARD CURRENT VERSUS FORWARD VOLTAGE



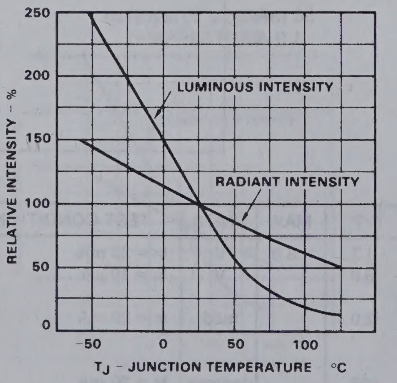
INTENSITY VERSUS FORWARD CURRENT



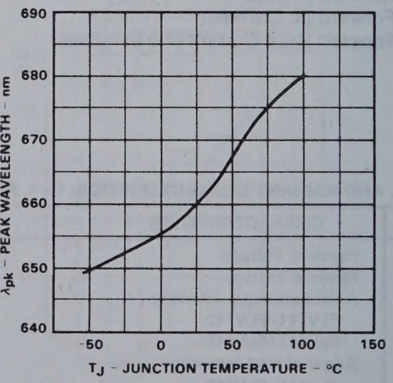
INTENSITY VERSUS VIEWING ANGLE



INTENSITY VERSUS TEMPERATURE



WAVELENGTH VERSUS TEMPERATURE



FLV141 • FLV151 • FLV161

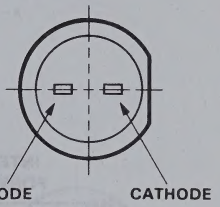
RED GaAsP LED LAMPS

OPTOELECTRONICS PRODUCT GROUP

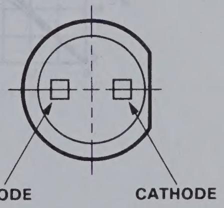
GENERAL DESCRIPTION — The FLV141, FLV151, and FLV161 are red light emitting diodes encapsulated in non-diffused plastic. These LED devices provide an intense light source for back lighting applications. Visual light emission is in the 600 nm to 700 nm range.

- SOLID STATE THUS NO REPLACEMENT REQUIRED
- NO SOCKET REQUIRED
- HIGH ON/OFF CONTRAST
- FLEXIBLE LEADS ON FLV141, AND FLV151
  FOR GOOD HEAT SINKING
  FOR RIGHT ANGLE BENDING
  FITS STANDARD SOCKETS AND DRILLED HOLES
- HEAVY COPPER LEADS ON FLV161
  FOR WIRE WRAPPING
  FOR RIGID STANDOFF FROM PC BOARD
- SINGLE MOLDED BODY ELIMINATES THERMAL CYCLING PROBLEMS
- HIGH TEMPERATURE EPOXY ENCAPUSLATION WITHSTANDS SEVERE ENVIRONMENTAL TEMPERATURES
- LOW POWER CONSUMPTION MEANS IC COMPATIBILITY

PIN CONNECTIONS



FLV141
FLV151



FLV161

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	−55°C to +125°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

Maximum Power Dissipation

Total Dissipation at $T_A = 25°C$	125 mW
Derate Linearly from 25°C	1.3 mW/°C

Maximum Voltage and Currents

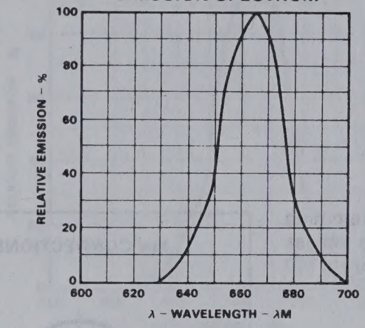
V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	50 mA
i_f	Peak Forward Current (1.0 μs pulse width)	1.0 A

ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

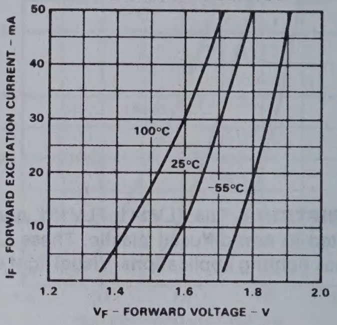
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.7	2.0	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	3.0	8.0		V	$I_R = 10\ \mu A$
I_O	Axial Luminous Intensity	0.8	2.0		mcd	$I_F = 20$ mA
$\theta_{1/2}$	Angle of Half Intensity		±35		degrees	$I_F = 20$ mA
λ_{pk}	Peak Wavelength		665		nm	$I_F = 20$ mA

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

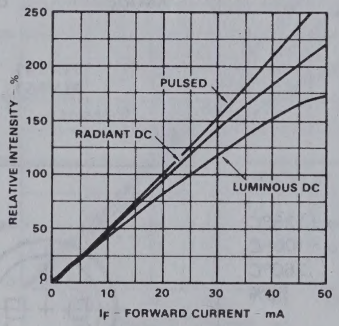
EMISSION SPECTRUM



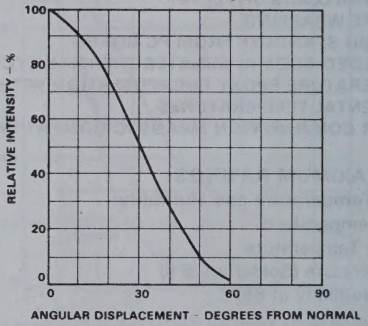
FORWARD CURRENT VERSUS FORWARD VOLTAGE



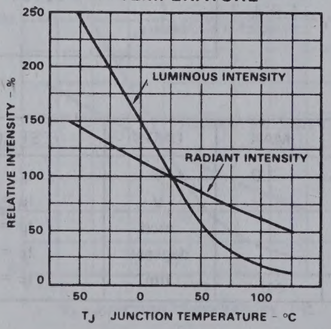
INTENSITY VERSUS FORWARD CURRENT



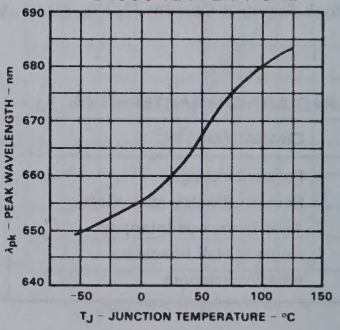
INTENSITY VERSUS VIEWING ANGLE



INTENSITY VERSUS TEMPERATURE



PEAK WAVELENGTH VERSUS TEMPERATURE



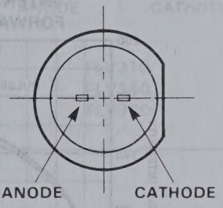
FLV251 • FLV252

RED GaP LED POINT SOURCE LAMPS

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The FLV251 and FLV252 are red GaP light emitting diodes encapsulated in red epoxy. These devices provide an intense light source with visual emission in the 600 to 850 nm range.

PIN CONNECTION



- **THREE TIMES BRIGHTER THAN GaAsP LAMPS AT EQUIVALENT CURRENTS**
- **SOLID STATE THUS NO REPLACEMENT IS REQUIRED**
- **HIGH ON/OFF CONTRAST**
- **FLEXIBLE PINS FOR GOOD HEAT SINKING AND RIGHT ANGLE BENDING**
- **FITS STANDARD SOCKETS AND DRILLED HOLES**
- **SINGLE MOLDED BODY ELIMINATES THERMAL CYCLING PROBLEMS**
- **HIGH TEMPERATURE EPOXY ENCAPSULATION WITHSTANDS SEVERE ENVIRONMENTAL TEMPERATURES**
- **FLV251 LIGHTS UP 1/4" DIAMETER CIRCLE WITH 3.0 mcd MINIMUM AT 10 mA**
- **FLV252 LIGHTS UP 1/4" DIAMETER CIRCLE WITH 6.0 mcd MINIMUM AT 10 mA**

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

Maximum Power Dissipation

Total Dissipation at T_A = 25°C	120 mW
Derate Linearly from 50°C	1.6 mW/°C

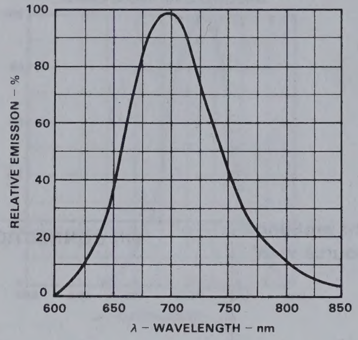
Maximum Voltage and Currents

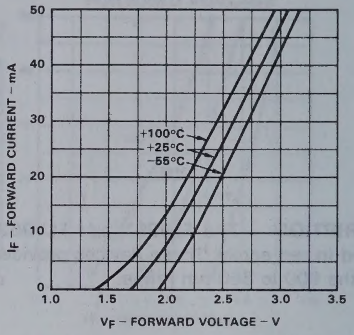
V_R	Reverse Voltage	5.0 V
I_F	Forward dc Current	35 mA

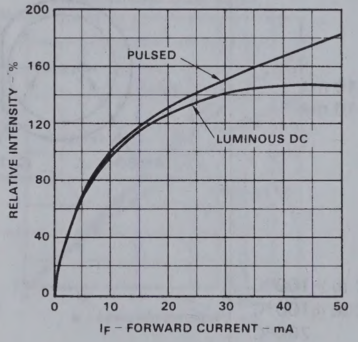
ELECTRICAL AND RADIANT CHARACTERISTICS: T_A = 25°C

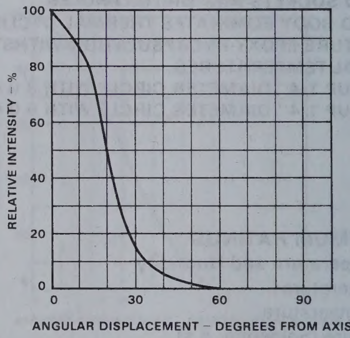
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		2.1	2.8	V	I_F = 10 mA
				3.0	V	I_F = 20 mA
BV_R	Reverse Breakdown Voltage	5.0	15		V	I_R = 100 μA
I_O	Axial Luminous Intensity					
	FLV251	3.0	5.0		mcd	I_F = 10 mA
	FLV252	6.0	8.0		mcd	I_F = 10 mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		±20		degrees	I_F = 20 mA
λ_{pk}	Peak Wavelength		690		nm	I_F = 10 mA

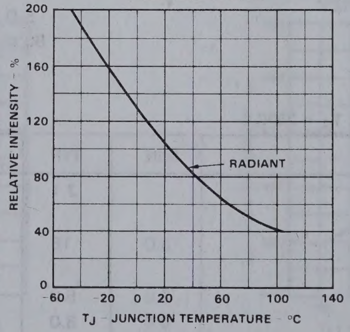
TYPICAL ELECTRICAL CHARACTERISTIC CURVES


EMISSION SPECTRUM


FORWARD CURRENT VERSUS FORWARD VOLTAGE


INTENSITY VERSUS FORWARD CURRENT


INTENSITY VERSUS VIEWING ANGLE


INTENSITY VERSUS TEMPERATURE

FLV310 • FLV340 • FLV350 • FLV360

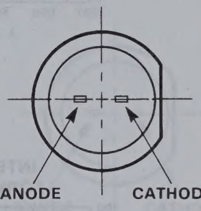
GREEN GaP LED LAMPS

OPTOELECTRONICS PRODUCT GROUP

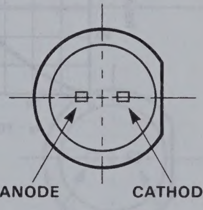
GENERAL DESCRIPTION – The FLV310, FLV340, FLV350 and FLV360 are green light emitting diodes encapsulated in green diffused plastic. These devices provide an intense large light source with wide angle viewing. Visual light emission is in the 525 to 625 nm range.

- HIGH LUMINOUS INTENSITY FOR ROOM AMBIENT LIGHT LEVELS
- SOLID STATE THUS NO REPLACEMENT IS REQUIRED
- HIGH ON/OFF CONTRAST
- FLEXIBLE PINS ON FLV310, FLV340 AND FLV350
    FOR GOOD HEAT SINKING
    FOR RIGHT ANGLE BENDING
    FITS STANDARD SOCKETS AND DRILLED HOLES
- HEAVY COPPER PINS ON FLV360 FOR WIRE WRAP APPLICATIONS AND RIGID STANDOFF FROM PC BOARD
- SINGLE MOLDED BODY ELIMINATES THERMAL CYCLING PROBLEMS
- HIGH TEMPERATURE EPOXY ENCAPSULATION WITHSTANDS SEVERE ENVIRONMENTAL TEMPERATURES
- LOW POWER MEANS IC COMPATIBILITY

PIN CONNECTIONS



FLV310
FLV340
FLV350



FLV360

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

Maximum Power Dissipation

Total Dissipation at $T_A = 25°C$	120 mW
Derate Linearly from 50°C	1.6 mW/°C

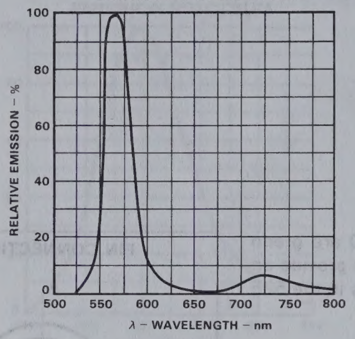
Maximum Voltage and Currents

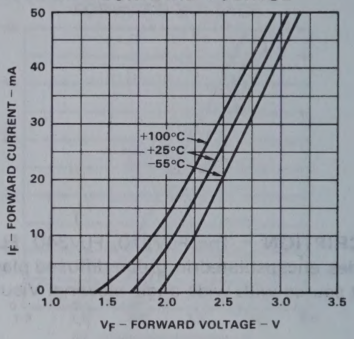
V_R	Reverse Voltage	5.0 V
I_F	Forward dc Current	35 mA
i_f	Peak Forward Current (1.0 μs pulse width)	1.0 A

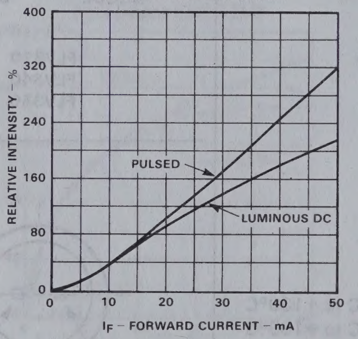
ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

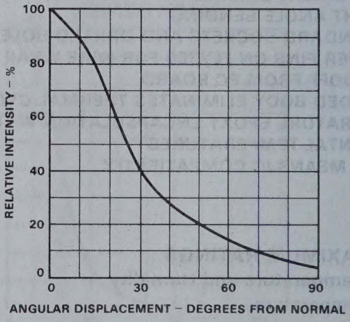
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		2.3	3.0	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	5.0	18		V	$I_R = 100\ \mu A$
I_O	Axial Luminous Intensity	1.6	3.2		mcd	$I_F = 20$ mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		±25		degrees	$I_F = 20$ mA
λ_{pk}	Peak Wavelength		565		nm	$I_F = 10$ mA

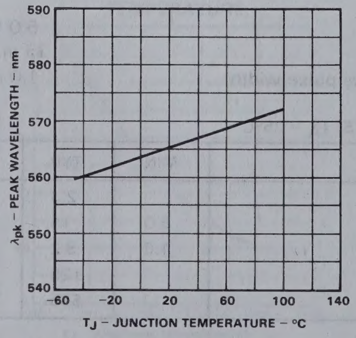
TYPICAL ELECTRICAL CHARACTERISTIC CURVES


EMISSION SPECTRUM


FORWARD CURRENT VERSUS FORWARD VOLTAGE


INTENSITY VERSUS FORWARD CURRENT


INTENSITY VERSUS VIEWING ANGLE


PEAK WAVELENGTH VERSUS TEMPERATURE

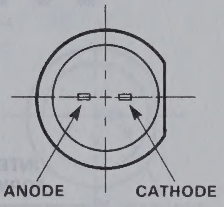
FLV311 • FLV341 • FLV351 • FLV361

GREEN GaP LED POINT-SOURCE LAMPS

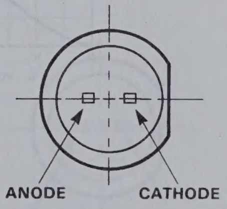
OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The FLV311, FLV341, FLV351 and FLV361 are green light emitting diodes encapsulated in green plastic for backlighting applications. These devices provide an intense light source with visual light in the 525 to 625 nm range.

PIN CONNECTIONS



FLV311
FLV341
FLV351



FLV361

- HIGH LUMINOUS INTENSITY
- SOLID STATE THUS NO REPLACEMENT IS REQUIRED
- SINGLE MOLDED BODY ELIMINATES THERMAL CYCLING PROBLEMS
- HIGH TEMPERATURE EPOXY ENCAPSULATION WITHSTANDS SEVERE ENVIRONMENTAL TEMPERATURES
- FLEXIBLE PINS FOR GOOD HEAT SINKING AND RIGHT ANGLE BENDING
- LOW POWER CONSUMPTION MEANS IC COMPATIBILITY
- FLV341 IS LESS THAN 1/4" TALL, FOR LOW PROFILE BACKLIGHTING
- FLV351 HAS A STANDARD MECHANICAL OUTLINE
- FLV361 FEATURES .025" PINS WITH STANDOFF

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

Maximum Power Dissipation

Total Dissipation at $T_A = 25°C$	120 mW
Derate Linearly from 50°C	1.6 mW/°C

Maximum Voltage and Currents

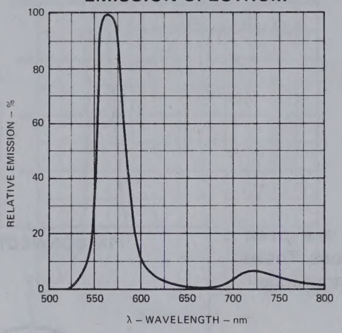
V_R	Reverse Voltage	5.0 V
I_F	Forward dc Current	35 mA
i_f	Peak Forward Current (1.0 μs pulse width)	1.0 A

ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

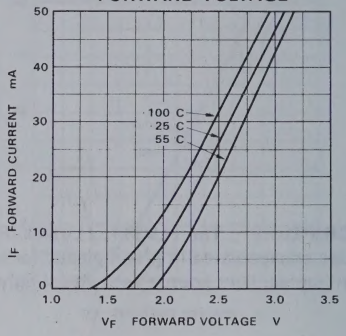
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		2.3	3.0	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	5.0	18		V	$I_R = 100$ μA
I_O	Axial Luminous Intensity	1.6	3.2		mcd	$I_F = 20$ mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		±20		degrees	$I_F = 20$ mA
λ_{pk}	Peak Wavelength		565		nm	$I_F = 20$ mA

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

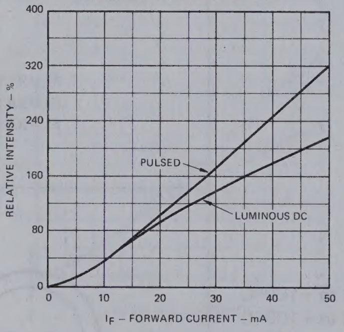
EMISSION SPECTRUM



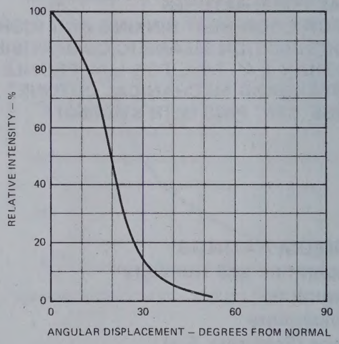
FORWARD CURRENT VERSUS FORWARD VOLTAGE



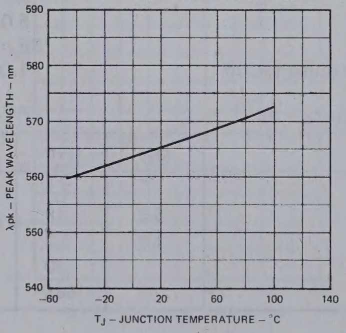
INTENSITY VERSUS FORWARD CURRENT



INTENSITY VERSUS VIEWING ANGLE



PEAK WAVELENGTH VERSUS TEMPERATURE



FLV410 • FLV440 • FLV450 • FLV460

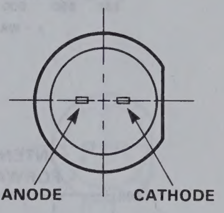
YELLOW GaP LED LAMPS

OPTOELECTRONICS PRODUCT GROUP

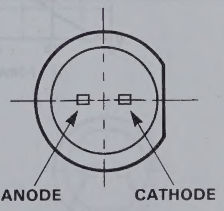
GENERAL DESCRIPTION — The FLV410, FLV440, FLV450 and FLV460 are yellow light-emitting diodes encapsulated in yellow diffused plastic. These devices provide an intense large area light source with wide angle viewing. Visual light emission is in the to 625 nm range.

- HIGH LUMINOUS INTENSITY FOR ROOM AMBIENT LIGHT LEVELS
- SOLID STATE THUS NO REPLACEMENT IS REQUIRED
- HIGH ON/OFF CONTRAST
- FLEXIBLE PINS ON FLV410, FLV440 AND FLV450
  - FOR GOOD HEAT SINKING
  - FOR RIGHT ANGLE BENDING
  - FITS STANDARD SOCKETS AND DRILLED HOLES
- HEAVY COPPER PINS ON FLV460 FOR WIRE WRAP APPLICATIONS AND RIGID STANDOFF FROM PC BOARD
- SINGLE MOLDED BODY ELIMINATES THERMAL CYCLING PROBLEMS
- HIGH TEMPERATURE EPOXY ENCAPSULATION WITHSTANDS SEVERE ENVIRONMENTAL TEMPERATURES
- LOW POWER MEANS IC COMPATIBILITY

PIN CONNECTIONS



FLV410
FLV440
FLV450



FLV460

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

Maximum Power Dissipation

Total Dissipation at T_A = 25°C	120 mW
Derate Linearly from 25°C	1.6 mW/°C

Maximum Voltage and Currents

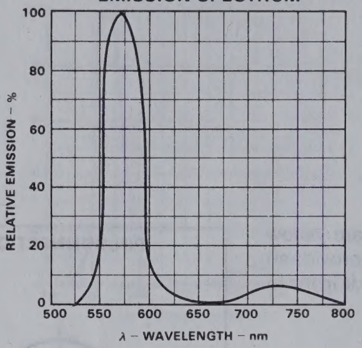
V_R	Reverse Voltage	5.0 V
I_F	Forward dc Current	10 mA
I_{pk}	Peak Forward Current (1.0 μs pulse width)	1.0 A

ELECTRICAL AND RADIANT CHARACTERISTICS: T_A = 25°C

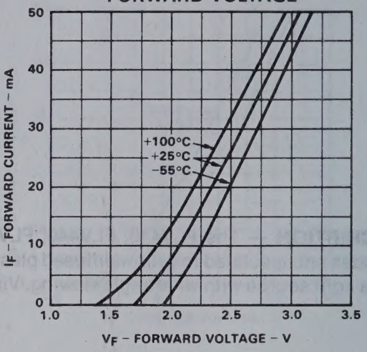
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		2.3	3.0	V	I_F = 20 mA
BV_R	Reverse Breakdown Voltage	5.0	18		V	I_R = 100 μA
I_O	Axial Luminous Intensity	1.6	3.2		mcd	I_F = 20 mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		±25		degrees	I_F = 20 mA
λ_{pk}	Peak Wavelength		585		nm	I_F = 20 mA

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

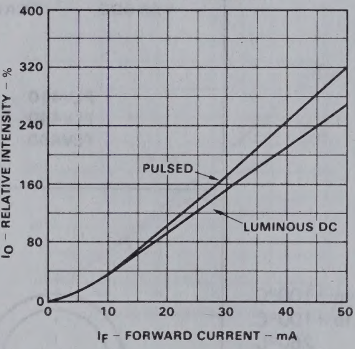
EMISSION SPECTRUM



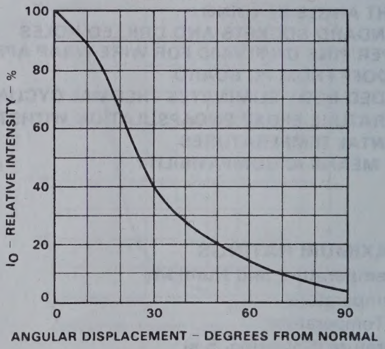
FORWARD CURRENT VERSUS FORWARD VOLTAGE



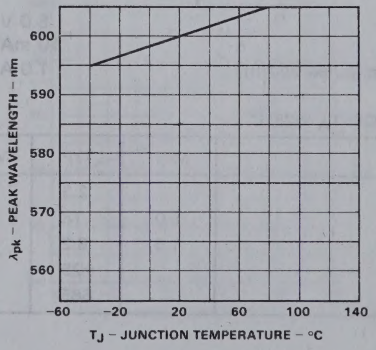
INTENSITY VERSUS FORWARD CURRENT



INTENSITY VERSUS VIEWING ANGLE



PEAK WAVELENGTH VERSUS TEMPERATURE



FLV411 • FLV441 • FLV451 • FLV461

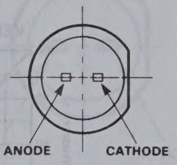
YELLOW GaP POINT SOURCE LED LAMPS

OPTOELECTRONICS PRODUCT GROUP

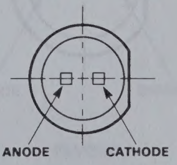
GENERAL DESCRIPTION—The FLV411, FLV441, FLV451 and FLV461 are yellow light emitting diodes encapsulated yellow non-diffused plastic. These LED devices provide an intense large area light source with narrow angle viewing. Visual light emission is in the 525 to 625 nm range.

- **HIGH LUMINOUS INTENSITY FOR ROOM AMBIENT LIGHT LEVELS**
- **SOLID STATE THUS NO REPLACEMENT IS REQUIRED**
- **HIGH ON/OFF CONTRAST**
- **FLEXIBLE PINS ON FLV411, FLV441 AND FLV451**
  FOR GOOD HEAT SINKING
  FOR RIGHT ANGLE BENDING
  FITS STANDARD SOCKETS AND DRILLED HOLES
- **HEAVY COPPER PINS ON FLV461 FOR WIRE WRAP APPLICATIONS AND RIGID STANDOFF FROM PC BOARD**
- **SINGLE MOLDED BODY ELIMINATES THERMAL CYCLING PROBLEMS**
- **HIGH TEMPERATURE EPOXY ENCAPSULATION WITHSTANDS SEVERE ENVIRONMENTAL TEMPERATURES**
- **LOW POWER MEANS IC COMPATIBILITY**

PIN CONNECTIONS



FLV411
FLV441
FLV451



FLV461

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Junction Temperature	125°C
Storage Temperature	-55°C to +150°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

Maximum Power Dissipation

Total Dissipation at $T_A = 25°C$	100 mW
Derate Linearly from 25°C	1.14 mW/°C

Maximum Voltage and Currents

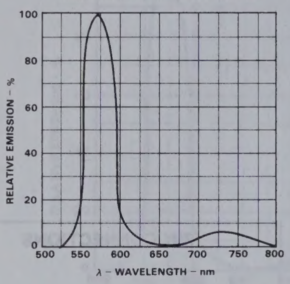
V_R	Reverse Voltage	5.0 V
I_F	Forward DC Current	35 mA
I_{pk}	Forward Peak Current (pulse = 1.0 μs)	1.0 A

ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

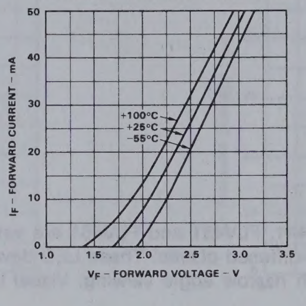
SYMBOL	CHARACTERISTICS	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		2.3	3.0	V	$I_F = 20$ mA
BV_R	Reverse Voltage	5.0	18		V	$I_R = 100\ \mu A$
I_O	Axial Luminous Intensity	1.6	3.2		mcd	$I_F = 20$ mA
$\theta_{1/2}$	Angle of Half Intensity		±20		degrees	$I_F = 20$ mA
λ_{pk}	Peak Wavelength		570		nm	$I_F = 20$ mA

TYPICAL ELECTRICAL CHARACTERISTICS

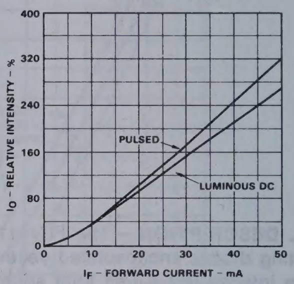
EMISSION SPECTRUM



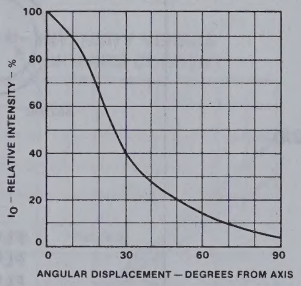
FORWARD CURRENT VERSUS FORWARD VOLTAGE



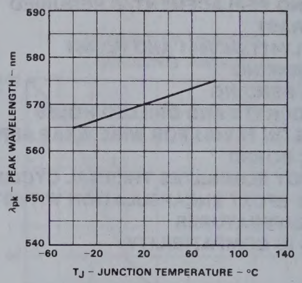
INTENSITY VERSUS FORWARD CURRENT



INTENSITY VERSUS VIEWING ANGLE



WAVELENGTH VERSUS TEMPERATURE



FLV510 • FLV540 • FLV550 • FLV560

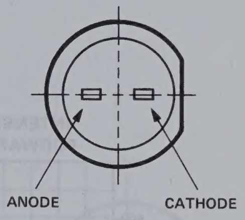
RED SUPER GaAsP LED LAMPS

OPTOELECTRONICS PRODUCT GROUP

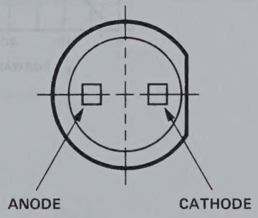
GENERAL DESCRIPTION – The FLV510, FLV540, FLV550 and FLV560 are red light emitting diodes encapsulated in red diffused plastic. These devices provide an intense large area light source with wide angle viewing. Visual light emission is in the 600 to 700 nm range.

- HIGH LUMINOUS INTENSITY FOR ROOM AMBIENT LIGHT LEVELS
- SOLID STATE THUS NO REPLACEMENT IS REQUIRED
- HIGH ON/OFF CONTRAST
- FLEXIBLE PINS ON FLV510, FLV540 AND FLV550
  - FOR GOOD HEAT SINKING
  - FOR RIGHT ANGLE BENDING
  - FITS STANDARD SOCKETS AND DRILLED HOLES
- HEAVY COPPER PINS ON FLV560 FOR WIRE WRAP APPLICATIONS AND RIGID STANDOFF FROM PC BOARD
- SINGLE MOLDED BODY ELIMINATES THERMAL CYCLING PROBLEMS
- HIGH TEMPERATURE EPOXY ENCAPSULATION WITHSTANDS SEVERE ENVIRONMENTAL TEMPERATURES
- LOW POWER MEANS IC COMPATIBILITY

PIN CONNECTIONS



FLV510
FLV540
FLV550



FLV560

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

Maximum Power Dissipation

Total Dissipation at $T_A = 25°C$	200 mW
Derate Linearly from 25°C	2.6 mW/°C

Maximum Voltage and Currents

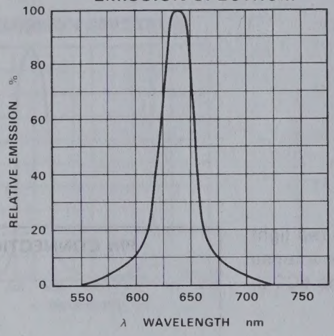
V_R	Reverse Voltage	5.0 V
I_F	Forward dc Current	35 mA
i_f	Peak Forward Current (1.0 μs pulse width)	1.0 A

ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

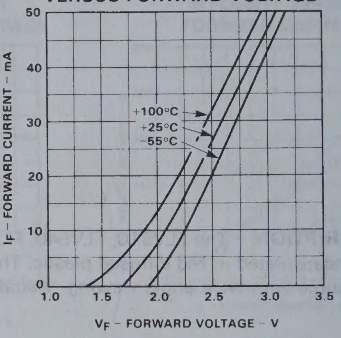
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		2.1	2.8	V	$I_F = 10$ mA
				3.0	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	5.0	8.0		V	$I_R = 100\ \mu A$
I_O	Axial Luminous Intensity	1.2	3.0		mcd	$I_F = 10$ mA
		2.0	5.0		mcd	$I_F = 20$ mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		±35		degrees	$I_F = 20$ mA
λ_{pk}	Peak Wavelength		640		nm	$I_F = 10$ mA

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

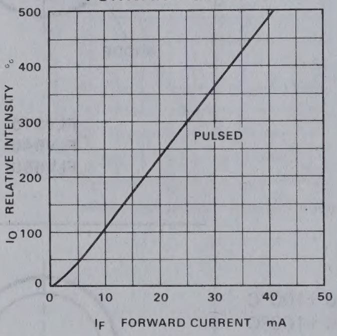
EMISSION SPECTRUM



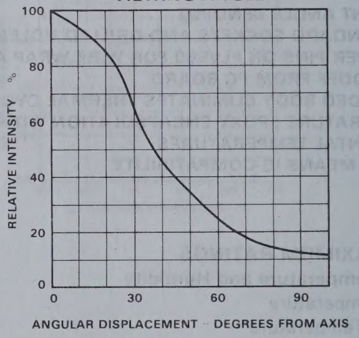
FORWARD CURRENT VERSUS FORWARD VOLTAGE



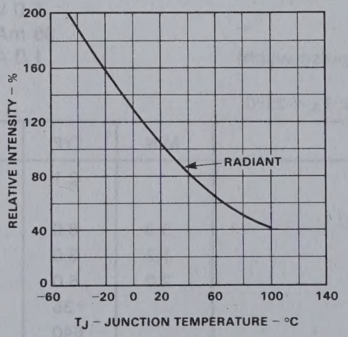
INTENSITY VERSUS FORWARD CURRENT



INTENSITY VERSUS VIEWING ANGLE



INTENSITY VERSUS TEMPERATURE



MV5050 • MV5051 • MV5052 • MV5053

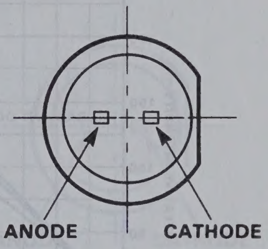
RED GaAsP LED LAMPS

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The MV5050, MV5051, MV5052 and MV5053 are red light emitting diodes encapsulated in diffused plastic. These devices provide an intense large area light source with wide angle viewing. Visual light emission is in the 600 nm to 700 nm range.

- **SOLID STATE THUS NO REPLACEMENT REQUIRED**
- **NO SOCKET REQUIRED**
- **HIGH ON/OFF CONTRAST**
- **FLEXIBLE PINS ON ALL LAMPS**
  - **FOR GOOD HEAT SINKING**
  - **FOR RIGHT ANGLE BENDING**
  - **FITS STANDARD SOCKETS OR DRILLED HOLES**
- **SINGLE MOLDED BODY ELIMINATES THERMAL CYCLING PROBLEMS**
- **HIGH TEMPERATURE EPOXY ENCAPSULATION WITHSTANDS SEVERE ENVIRONMENTAL TEMPERATURES**
- **LOW POWER CONSUMPTION MEANS IC COMPATIBILITY**
- **MV5050 IN CLEAR NON-DIFFUSED EPOXY**
- **MV5051 IN CLEAR DIFFUSED EPOXY**
- **MV5052 IN RED NON-DIFFUSED EPOXY**
- **MV5053 IN RED DIFFUSED EPOXY**

CONNECTION DIAGRAM
(TOP VIEW)



ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

Maximum Power Dissipation

Total Dissipation at $T_A = 25°C$	125 mW
Derate Linearly from 25°C	1.3 mW/°C

Maximum Voltage and Currents

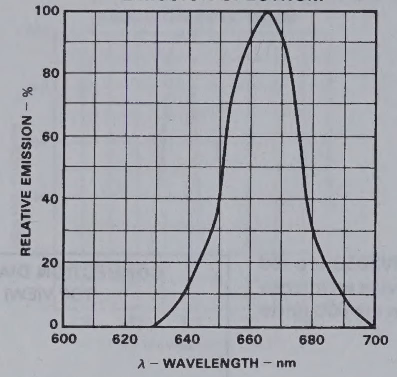
V_R	Reverse Voltage	5.0 V
I_F	Forward Current at $T_A = 25°C$	100 mA
	at $T_A = 100°C$	15 mA
i_f	Peak Forward Current (1.0 μs pulse width, 0.1% duty cycle)	1.0 A

ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

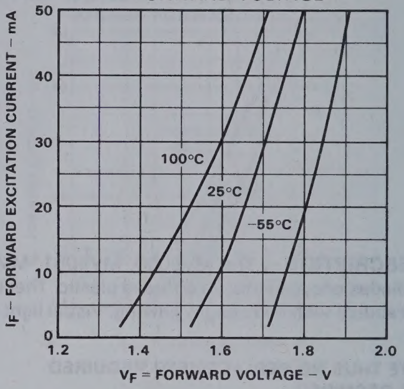
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.7	2.2	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	5.0	25		V	$I_R = 100\ \mu A$
I_O	Axial Luminous Intensity				mcd	$I_F = 20$ mA
	MV5050/MV5052		2.0			
	MV5051/MV5053		1.6			
$\theta_{1/2}$	Viewing Angle to Half Intensity				degrees	$I_F = 20$ mA
	MV5050		±25			
	MV5051/MV5052		±35			
	MV5053		±40			
λ_{pk}	Peak Wavelength		660		nm	$I_F = 20$ mA

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

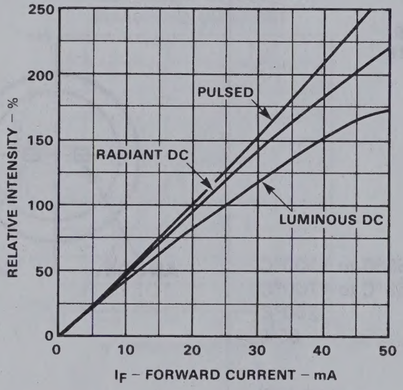
EMISSION SPECTRUM



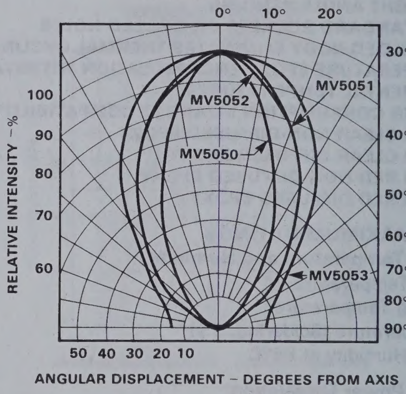
FORWARD CURRENT VERSUS FORWARD VOLTAGE



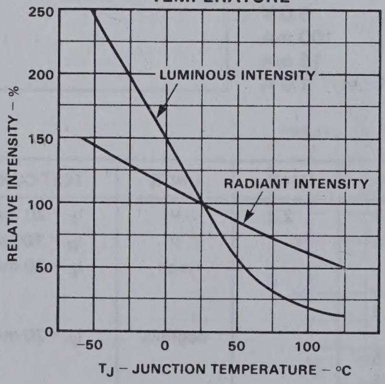
INTENSITY VERSUS FORWARD CURRENT



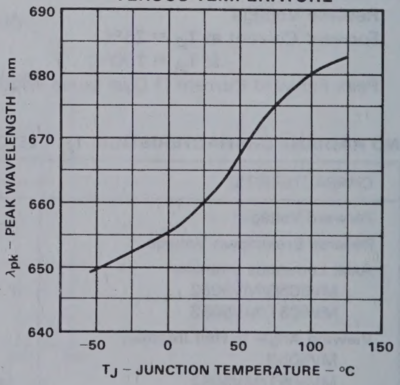
INTENSITY VERSUS VIEWING ANGLE



INTENSITY VERSUS TEMPERATURE



PEAK WAVELENGTH VERSUS TEMPERATURE



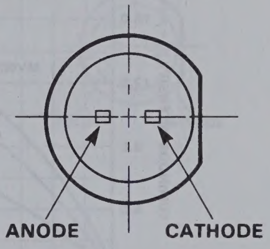
MV5054-1 • MV5054-2 • MV5054-3

RED GaAsP LED LAMPS

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The MV5054 series lamps are red light emitting diodes encapsulated in red diffused plastic. These devices provide an intense large area light source with wide angle viewing. Visual light emission is in the 600 nm to 700 nm range. Three brightness levels are available.

CONNECTION DIAGRAM
(TOP VIEW)



- **SOLID STATE THUS NO REPLACEMENT REQUIRED**
- **NO SOCKET REQUIRED**
- **HIGH ON/OFF CONTRAST**
- **FLEXIBLE PINS ON ALL LAMPS**
  - **FOR GOOD HEAT SINKING**
  - **FOR RIGHT ANGLE BENDING**
  - **FITS STANDARD SOCKETS OR DRILLED HOLES**
- **SINGLE MOLDED BODY ELIMINATES THERMAL CYCLING PROBLEMS**
- **HIGH TEMPERATURE EPOXY ENCAPSULATION WITHSTANDS SEVERE ENVIRONMENTAL TEMPERATURES**
- **LOW POWER CONSUMPTION MEANS IC COMPATIBILITY**
- **MV5054-1 HAS 2.0 mcd TYP LUMINOUS INTENSITY**
- **MV5054-2 HAS 3.0 mcd TYP LUMINOUS INTENSITY**
- **MV5054-3 HAS 4.0 mcd TYP LUMINOUS INTENSITY**

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

Maximum Power Dissipation

Total Dissipation at $T_A = 25°C$	125 mW
Derate Linearly from 25°C	1.3 mW/°C

Maximum Voltage and Currents

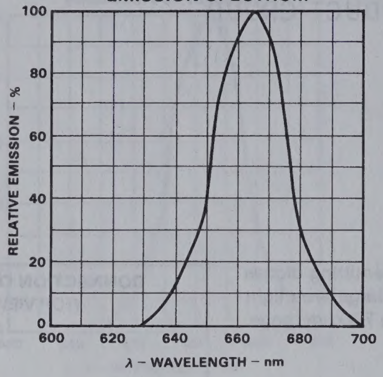
V_R	Reverse Voltage	5.0 V
I_F	Forward Current at $T_A = 25°C$	100 mA
	at $T_A = 100°C$	15 mA
i_f	Peak Forward Current (1.0 μs pulse width, 0.1% duty cycle)	1.0 A

ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

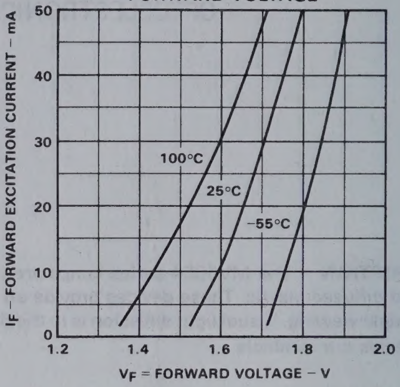
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.8	2.2	V	$I_F = 10$ mA
BV_R	Reverse Breakdown Voltage	5.0	25		V	$I_R = 100\ \mu A$
I_O	Axial Luminous Intensity				mcd	$I_F = 10$ mA
	MV5054-1	1.0	2.0			
	MV5054-2	2.0	3.0			
	MV5054-3	3.0	4.0			
$\theta_{1/2}$	Viewing Angle to Half Intensity		±12		degrees	$I_F = 20$ mA
λ_{pk}	Peak Wavelength		660		nm	$I_F = 20$ mA

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

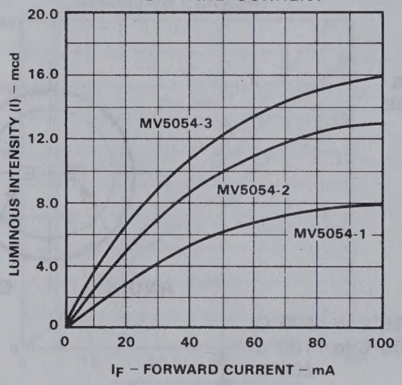
EMISSION SPECTRUM



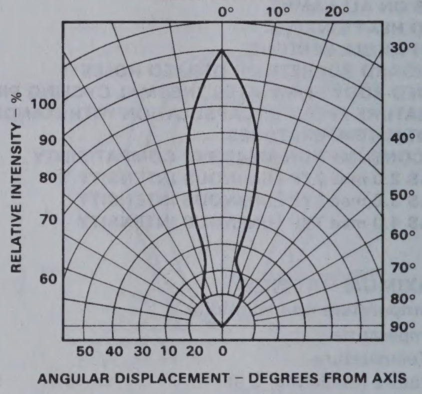
FORWARD CURRENT VERSUS FORWARD VOLTAGE



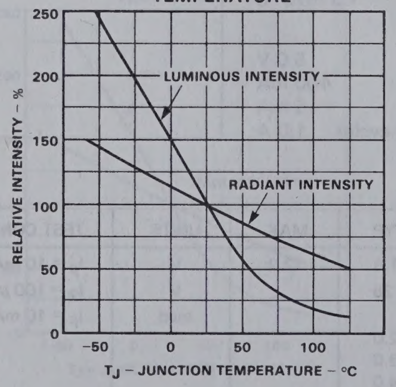
INTENSITY VERSUS FORWARD CURRENT



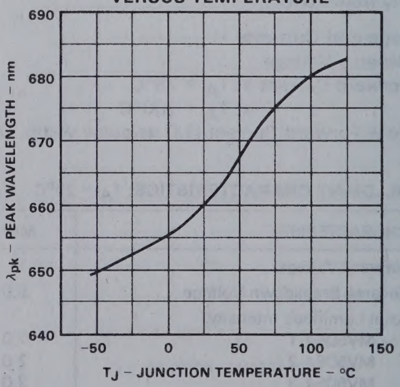
INTENSITY VERSUS VIEWING ANGLE



INTENSITY VERSUS TEMPERATURE



PEAK WAVELENGTH VERSUS TEMPERATURE



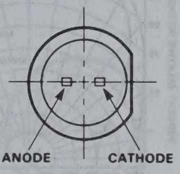
MV5055 • MV5056

WIDE ANGLE RED GaAsP LED LAMPS

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION — The MV5055 and MV5056 are red light emitting diodes encapsulated in diffused plastic. These LED devices provide an intense large area light source. Visual light emission is in the 600 nm to 700 nm range. The design has maximized viewing angle.

CONNECTION DIAGRAM
(TOP VIEW)



- **SOLID STATE THUS NO REPLACEMENT REQUIRED**
- **NO SOCKET REQUIRED**
- **HIGH ON/OFF CONTRAST**
- **FLEXIBLE PINS ON ALL LAMPS**
  - **FOR GOOD HEAT SINKING**
  - **FOR RIGHT ANGLE BENDING**
  - **FITS STANDARD SOCKETS FOR DRILLED HOLES**
- **SINGLE MOLDED BODY ELIMINATES THERMAL CYCLING PROBLEMS**
- **HIGH TEMPERATURE EPOXY ENCAPSULATION WITHSTAND SEVERE ENVIRONMENTAL TEMPERATURES**
- **LOW POWER CONSUMPTION MEANS IC COMPATIBILITY**
- **MV5055 IN RED DIFFUSED EPOXY**
- **MV5056 IN RED DIFFUSED EPOXY**

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Operating Temperature	-55°C to +110°C
Storage Temperature	-55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

Maximum Power Dissipation

Total Dissipation at $T_A = 25°C$	125 mW
Derate Linearly from 25°C	1.3 mW/°C

Maximum Voltage and Currents

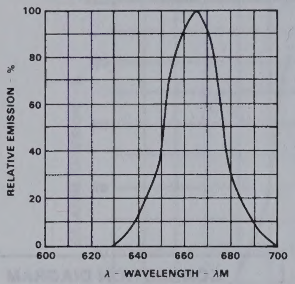
V_R	Reverse Voltage	5.0 V
I_F	Forward Current at $T_A = 25°C$	100 mA
	at $T_A = 100°C$	15 mA
I_{PK}	Forward Peak Current (1.0 μs pulse)	1.0 A

ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

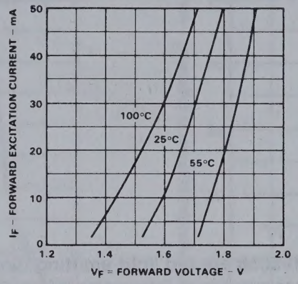
SYMBOL	CHARACTERISTICS	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.7	2.2	V	$I_F = 20$ mA
V_R	Reverse Voltage	5.0	25		V	$I_R = 100\ \mu A$
I_O	Axial Luminous Intensity				mcd	$I_F = 20$ mA
	MV5055		0.6			
	MV5056		0.8			
$\theta_{1/2}$	Viewing Angle to Half Intensity				degrees	$I_F = 20$ mA
	MV5055		±75			
	MV5056		±55			
λ_{pk}	Peak Wavelength		660		nm	$I_F = 20$ mA

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

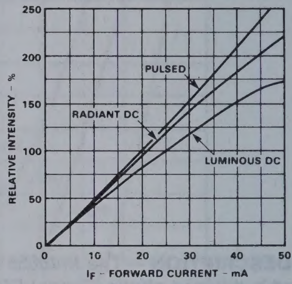
EMISSION SPECTRUM



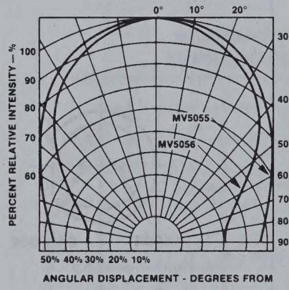
FORWARD CURRENT VERSUS FORWARD VOLTAGE



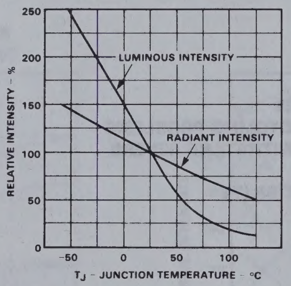
INTENSITY VERSUS FORWARD CURRENT



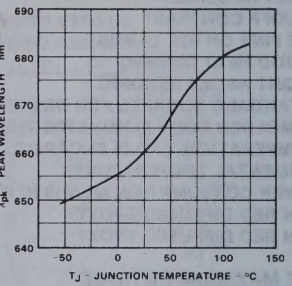
INTENSITY VERSUS ANGLE



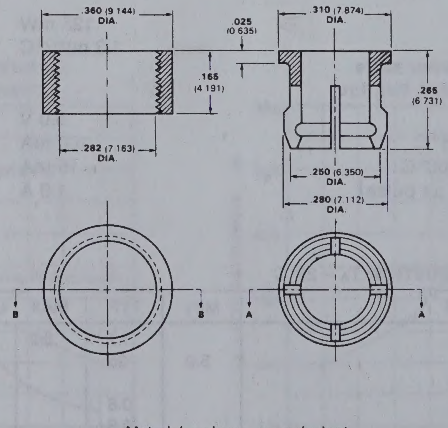
INTENSITY VERSUS TEMPERATURE



WAVELENGTH VERSUS TEMPERATURE



MP52 MOUNTING HARDWARE


.360 (9.144) DIA.
.025 (0.635)
.310 (7.874) DIA.
.165 (4.191)
.265 (6.731)
.282 (7.163) DIA.
.250 (6.350) DIA.
.280 (7.112) DIA.
B
B
A
A

Material: polypro or equivalent
For mounting drill a .25" hole

MV5152 • MV5153 • MV5154

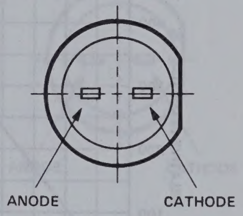
AMBER SUPER GaAsP LED LAMPS

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The MV5152, MV5153 and MV5154 are red light emitting diodes encapsulated in amber epoxy. Viewing angle can be selected from point source to wide angle. Visual light emission is in the 590 nm to 660 nm range.

- **HIGH LUMINOUS INTENSITY FOR AMBIENT LIGHT LEVELS**
- **SOLID STATE – NO REPLACEMENT REQUIRED**
- **HIGH ON/OFF CONTRAST**
- **FLEXIBLE PINS ON ALL LAMPS**
  FOR GOOD HEAT SINKING
  FOR RIGHT ANGLE BENDING
  FITS STANDARD SOCKETS OR DRILLED HOLES
- **SINGLE MOLDED BODY ELIMINATES THERMAL CYCLING PROBLEMS**
- **LOW POWER FOR IC COMPATIBILITY**
- **MV5152 FOR POINT SOURCE LAMPS**
- **MV5153 FOR WIDE ANGLE LAMPS**
- **MV5154 FOR INTERMEDIATE DISPERSION LAMPS**

CONNECTION DIAGRAM
(TOP VIEW)



ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

Maximum Power Dissipation

Total Dissipation at T_A = 25°C	105 mW
Derate Linearly from 25°C	1.14 mW/°C

Maximum Voltage and Currents

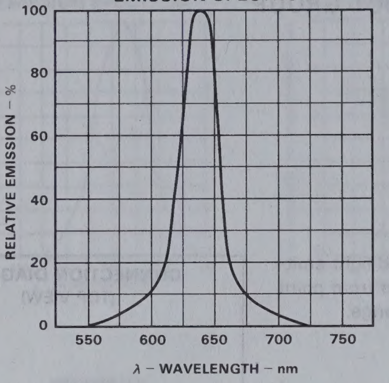
V_R	Reverse Voltage	5.0 V
I_F	Forward Current at T_A = 25°C	35 mA
i_f	Peak Forward Current (1.0 μs pulse width, 0.1% duty cycle)	1.0 A

ELECTRICAL AND RADIANT CHARACTERISTICS: T_A = 25°C

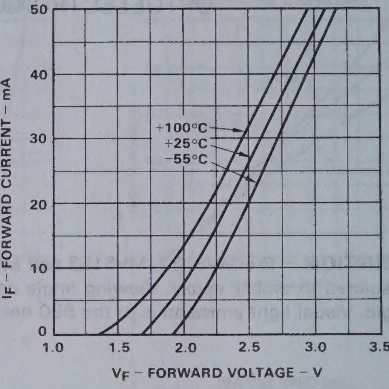
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		2.0	3.0	V	I_F = 20 mA
BV_R	Reverse Breakdown Voltage	5.0	25		V	I_R = 100 μA
I_O	Axial Luminous Intensity				mcd	I_F = 20 mA
	MV5152		20			
	MV5153		4.0			
	MV5154		8.0			
$\theta_{1/2}$	Viewing Angle to Half Intensity				degrees	I_F = 20 mA
	MV5152		±10			
	MV5153		±32			
	MV5154		±12			
λ_{pk}	Peak Wavelength		635		nm	I_F = 20 mA

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

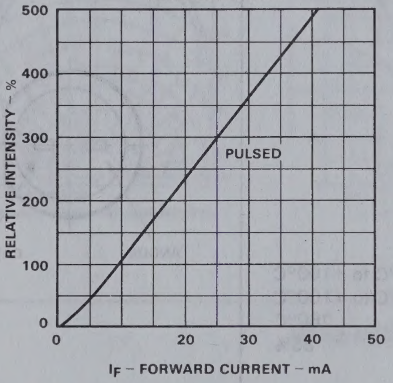
EMISSION SPECTRUM



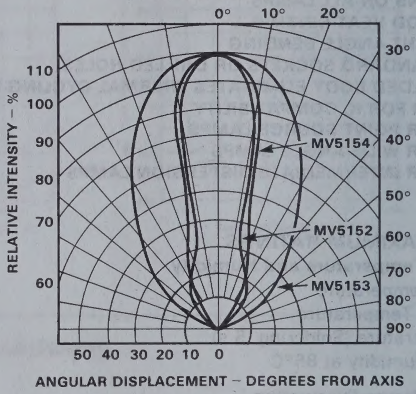
FORWARD CURRENT VERSUS FORWARD VOLTAGE



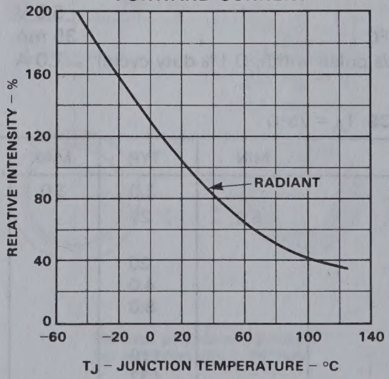
INTENSITY VERSUS TEMPERATURE



INTENSITY VERSUS VIEWING ANGLE



INTENSITY VERSUS FORWARD CURRENT



MV5252 • MV5253 • MV5254

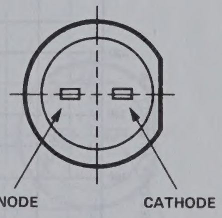
GREEN GaP LED LAMPS

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The MV5252, MV5253 and MV5254 are green light emitting diodes encapsulated in green epoxy. Viewing angle can be selected from point source to wide angle. Visual light emission is in the 530 nm to 590 nm range.

- **HIGH LUMINOUS INTENSITY FOR AMBIENT LIGHT LEVELS**
- **SOLID STATE – NO REPLACEMENT REQUIRED**
- **HIGH ON/OFF CONTRAST**
- **FLEXIBLE PINS ON ALL LAMPS**
  - **FOR GOOD HEAT SINKING**
  - **FOR RIGHT ANGLE BENDING**
  - **FITS STANDARD SOCKETS OR DRILLED HOLES**
- **SINGLE MOLDED BODY ELIMINATES THERMAL CYCLING PROBLEMS**
- **LOW POWER FOR IC COMPATIBILITY**
- **MV5252 FOR POINT SOURCE LAMPS**
- **MV5253 FOR WIDE ANGLE LAMPS**
- **MV5254 FOR INTERMEDIATE DISPERSION LAMPS**

CONNECTION DIAGRAM
(TOP VIEW)



ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

Maximum Power Dissipation

Total Dissipation at $T_A = 25°C$	105 mW
Derate Linearly from 25°C	1.14 mW/°C

Maximum Voltage and Currents

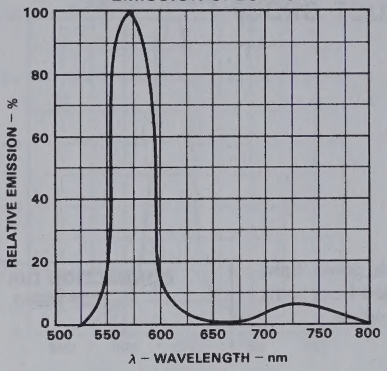
V_R	Reverse Voltage	5.0 V
I_F	Forward Current at $T_A = 25°C$	35 mA
i_f	Peak Forward Current (1.0 μs pulse width, 0.1% duty cycle)	1.0 A

ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

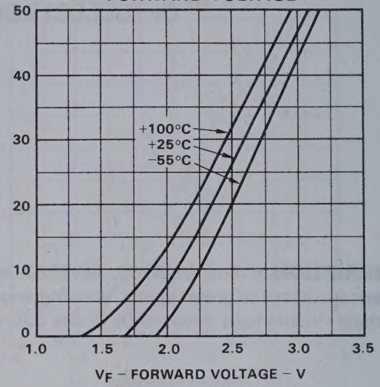
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		2.2	3.0	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	5.0	25		V	$I_R = 100$ μA
I_O	Axial Luminous Intensity				mcd	$I_F = 20$ mA
	MV5252		30.0			
	MV5253		3.0			
	MV5254		6.0			
$\theta_{1/2}$	Viewing Angle to Half Intensity				degrees	$I_F = 20$ mA
	MV5252		±10			
	MV5253		±32			
	MV5254		±12			
λ_{pk}	Peak Wavelength		565		nm	$I_F = 20$ mA

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

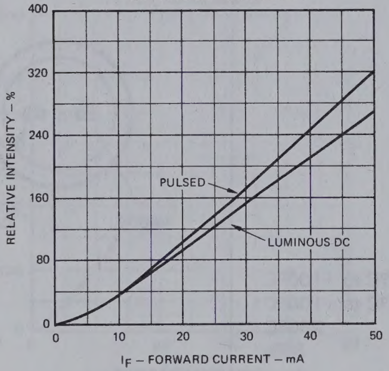
EMISSION SPECTRUM



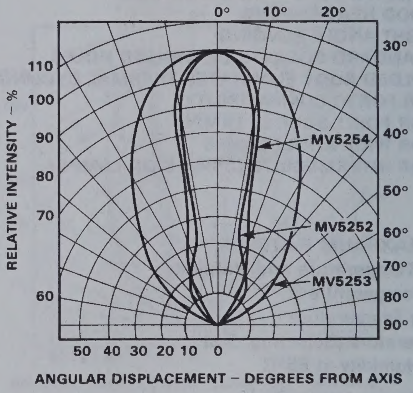
FORWARD CURRENT VERSUS FORWARD VOLTAGE



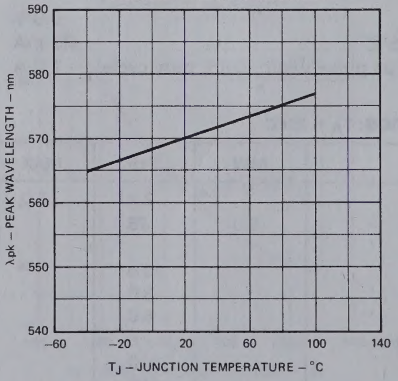
INTENSITY VERSUS FORWARD CURRENT



INTENSITY VERSUS VIEWING ANGLE



PEAK WAVELENGTH VERSUS TEMPERATURE



MV5352 • MV5353 • MV5354

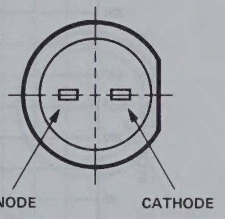
YELLOW GaP LED LAMPS

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The MV5352, MV5353 and MV5354 are yellow light emitting diodes encapsulated in yellow epoxy. Viewing angle can be selected from point source to wide angle. Visual light emission is in the 525 nm to 625 nm range.

- HIGH LUMINOUS INTENSITY FOR AMBIENT LIGHT LEVELS
- SOLID STATE – NO REPLACEMENT REQUIRED
- HIGH ON/OFF CONTRAST
- FLEXIBLE PINS ON ALL LAMPS
    FOR GOOD HEAT SINKING
    FOR RIGHT ANGLE BENDING
    FITS STANDARD SOCKETS OR DRILLED HOLES
- SINGLE MOLDED BODY ELIMINATES THERMAL CYCLING PROBLEMS
- LOW POWER FOR IC COMPATIBILITY
- MV5352 FOR POINT SOURCE LAMPS
- MV5353 FOR WIDE ANGLE LAMPS
- MV5354 FOR INTERMEDIATE DISPERSION LAMPS

CONNECTION DIAGRAM
(TOP VIEW)



ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

Maximum Power Dissipation

Total Dissipation at $T_A = 25°C$	105 mW
Derate Linearly from 25°C	1.14 mW/°C

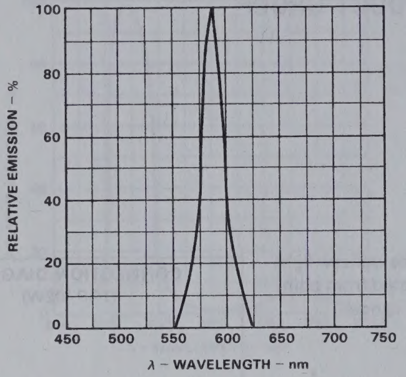
Maximum Voltage and Currents

V_R	Reverse Voltage	5.0 V
I_F	Forward Current at $T_A = 25°C$	35 mA
i_f	Peak Forward Current (1.0 μs pulse width, 0.1% duty cycle)	1.0 A

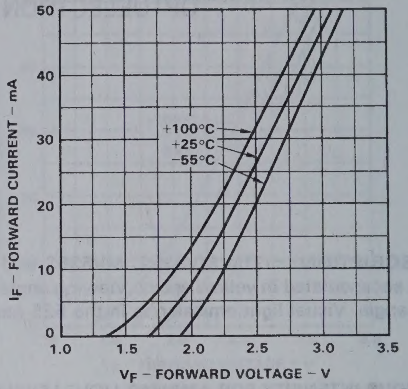
ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		2.1	3.0	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	5.0	25		V	$I_R = 100\ \mu A$
I_O	Axial Luminous Intensity				mcd	$I_F = 20$ mA
	MV5352		20			
	MV5353		6.0			
	MV5354		10			
$\theta_{1/2}$	Viewing Angle to Half Intensity				degrees	$I_F = 20$ mA
	MV5352		±10			
	MV5353		±32			
	MV5354		±12			
λ_{pk}	Peak Wavelength		585		nm	$I_F = 20$ mA

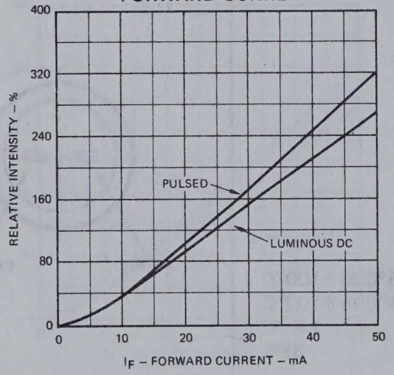
TYPICAL ELECTRICAL CHARACTERISTIC CURVES



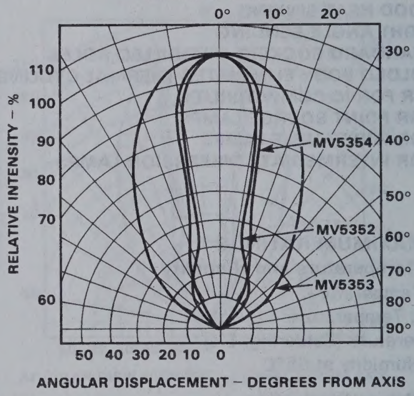
EMISSION SPECTRUM



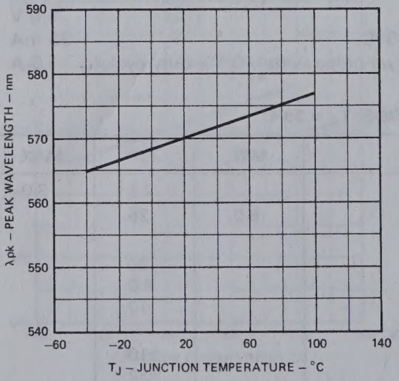
FORWARD CURRENT VERSUS FORWARD VOLTAGE



INTENSITY VERSUS FORWARD CURRENT



INTENSITY VERSUS VIEWING ANGLE



PEAK WAVELENGTH VERSUS TEMPERATURE

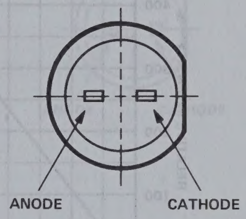
MV5752 • MV5753 • MV5754

RED SUPER GaAsP LED LAMPS

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The MV5752, MV5753 and MV5754 are red light emitting diodes encapsulated in red epoxy. Viewing angle can be selected from point source to wide angle. Visual light emission is in the 590 nm to 660 nm range.

CONNECTION DIAGRAM
(TOP VIEW)



- **HIGH LUMINOUS INTENSITY FOR AMBIENT LIGHT LEVELS**
- **SOLID STATE – NO REPLACEMENT REQUIRED**
- **HIGH ON/OFF CONTRAST**
- **FLEXIBLE PINS ON ALL LAMPS**
  FOR GOOD HEAT SINKING
  FOR RIGHT ANGLE BENDING
  FITS STANDARD SOCKETS OR DRILLED HOLES
- **SINGLE MOLDED BODY ELIMINATES THERMAL CYCLING PROBLEMS**
- **LOW POWER FOR IC COMPATIBILITY**
- **MV5752 FOR POINT SOURCE LAMPS**
- **MV5753 FOR WIDE ANGLE LAMPS**
- **MV5754 FOR INTERMEDIATE DISPERSION LAMPS**

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

Maximum Power Dissipation

Total Dissipation at $T_A = 25°C$	105 mW
Derate Linearly from 25°C	1.14 mW/°C

Maximum Voltage and Currents

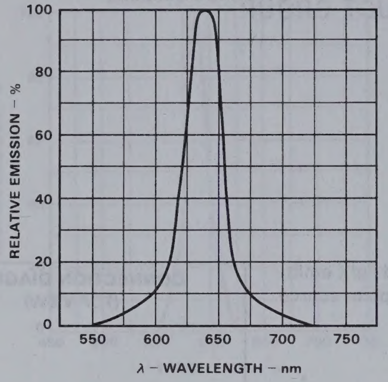
V_R	Reverse Voltage	5.0 V
I_F	Forward Current at $T_A = 25°C$	35 mA
i_f	Peak Forward Current (1.0 μs pulse width, 0.1% duty cycle)	1.0 A

ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

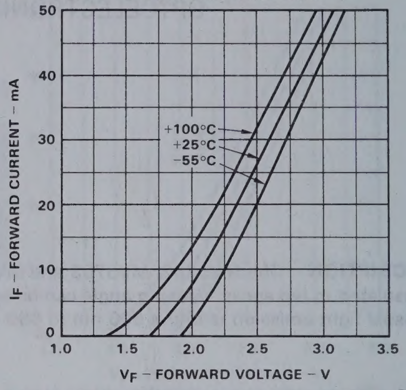
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		2.0	3.0	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	5.0	25		V	$I_R = 100\ \mu A$
I_O	Axial Luminous Intensity				mcd	$I_F = 20$ mA
	MV5752		16			
	MV5753		4.0			
	MV5754		8.0			
$\theta_{1/2}$	Viewing Angle to Half Intensity				degrees	$I_F = 20$ mA
	MV5752		±10			
	MV5753		±32			
	MV5754		±12			
λ_{pk}	Peak Wavelength		635		nm	$I_F = 20$ mA

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

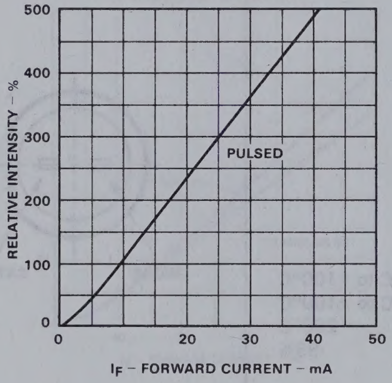
EMISSION SPECTRUM



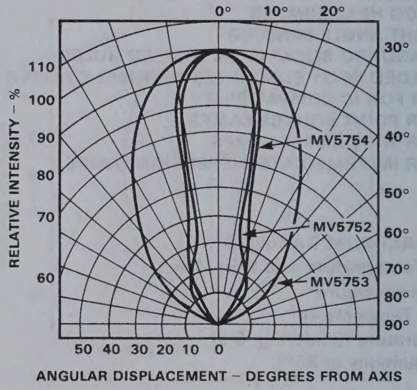
FORWARD CURRENT VERSUS FORWARD VOLTAGE



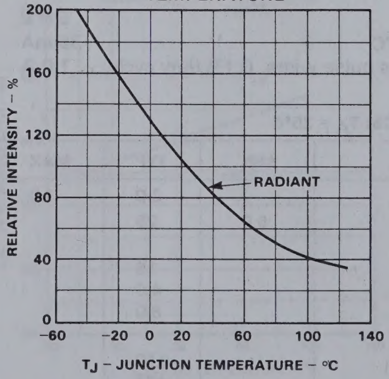
INTENSITY VERSUS FORWARD CURRENT



INTENSITY VERSUS VIEWING ANGLE



INTENSITY VERSUS TEMPERATURE



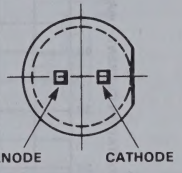
TIL209A • TIL211 • TIL213

RED,GREEN AND YELLOW T-1 LED LAMPS

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The TIL209A is a red GaAsP T-1 lamp. TheTIL211 is a green GaP T-1 lamp, and the TIL213 is a yellow T-1 lamp. These devices provide a low-cost lamp for applications where space is at a premium.

PIN CONNECTION



- **SMALL SIZE**
- **THREE COLORS AVAILABLE**
- **LOW POWER CONSUMPTION MEANS IC COMPATABILITY**
- **NO SOCKET REQUIRED**

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Operating Temperature	−40°C to +80°C
Storage Temperature	−40°C to +80°C
Pin Temperature (Soldering, 5 s)	230°C
Relative Humidity at 85 °C	85%

Maximum Power Dissipation

Total Dissipation at $T_A = 25°C$	100 mW
Derate Linearly from 25°C	1.33 mW/°C

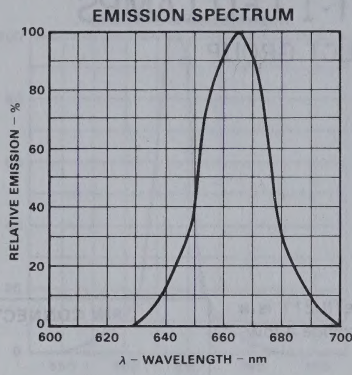
Maximum Voltage and Currents

V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	
	TIL209A	40 mA
	TIL211, TIL213	30 mA
i_f	Peak Forward Current (1.0 μs pulse width)	1.0 A

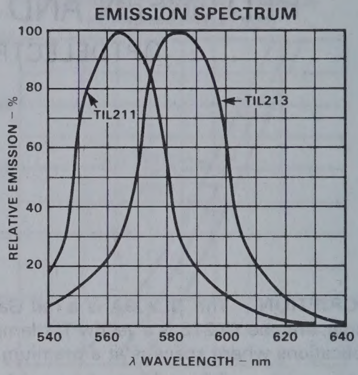
ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage					
	TIL209A		1.6	2.0	V	$I_F = 20$ mA
	TIL211, TIL213		2.3	3.0	V	$I_F = 25$ mA
V_R	Reverse Voltage					
	TIL209A, TIL211, TIL213	3.0			V	$I_R = 100$ μA
I_O	Axial Luminous Intensity					
	TIL209A	500	1000		μcd	$I_F = 20$ mA
	TIL211, TIL213	800	4000		μcd	$I_F = 25$ mA
λ_{pk}	Peak Wavelength					
	TIL209A		665		nm	$I_F = 20$ mA
	TIL211		565		nm	$I_F = 20$ mA
	TIL213		585		nm	$I_F = 20$ mA

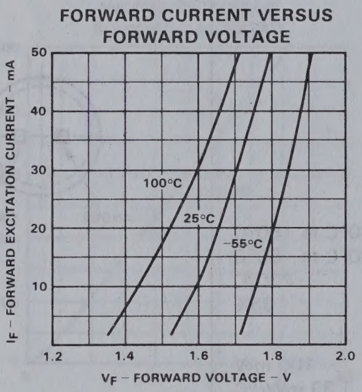
TYPICAL ELECTRICAL CHARACTERISTIC CURVES



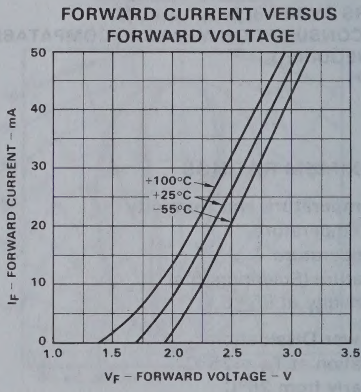
TIL 209A



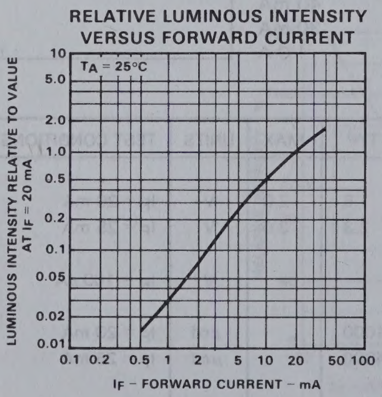
TIL 211, TIL 213



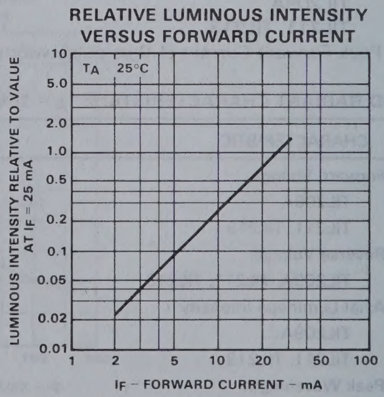
TIL 209A



TIL 211, TIL 213



TIL 209A



TIL 211, TIL 213

FLS010

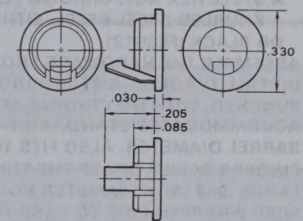
FRONT PANEL ADAPTER

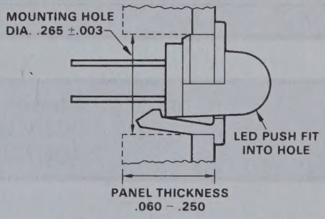
FOR LED LAMP

GENERAL DESCRIPTION – The FLS010 is a panel mount adapter specially designed for use with all Fairchild .200″ LED lamps.

- SINGLE PART CONSTRUCTION
- SIMPLE ASSEMBLY TECHNIQUE
- BLACK FINISH GIVES MAXIMUM ON/OFF CONTRAST
- FITS PANELS .060″ to .250″ THICK
- FITS LAMPS .280″ THROUGH .360″ TALL
- REMOVABLE FROM EITHER FRONT OR REAR
- ORIENTS TO FLAT ON LED FOR EASY POLARITY INSPECTION
- NEARLY FLUSH WITH FRONT PANEL SURFACE
- REQUIRES STANDARD H-SIZE DRILL HOLE IN PANEL

PHYSICAL DIMENSIONS





MOUNTING INSTRUCTIONS

1. The panel hole for the mounting clip should be o.265″ (±.002″) and the hole edges should be deburred (this permits a 17/64 or H size drill to be used).
2. Insert the LED, lens first, with the flat flush against the tab, into the tab end of the clip. Press firmly until the tab snaps over the flat and locks the unit into the clip.
3. Insert the mounting clip and LED assembly into the panel hole, pins first, from the front side of the panel. Use a hollowed cylinder whose internal diameter is greater than .200″ and less than .24″ (i.e. either a piece of 3/8″ poly-flo tubing or 3/16″ nut driver) to ″press fit″ the clip into the panel until the flange is seated snugly on the panel.

FLS011 · FLS012

PANEL MOUNTING HARDWARE KIT

FOR T-1 3/4 LED LAMPS

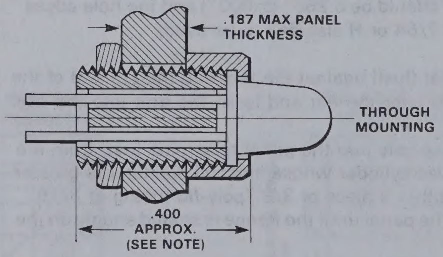
OPTOELECTRONICS PRODUCT GROUP

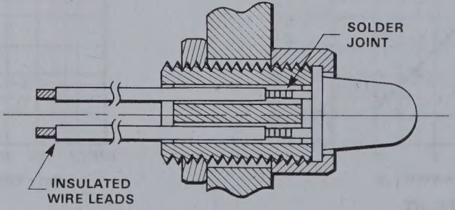
GENERAL DESCRIPTION – Simplify the assembly and removal of LED lamps by using the FLS011 or FLS012 mounting hardware kit.

- THREE PIECES:
  - A GLASS FILLED BLACK NYLON BARREL.
  - A STEEL HEX NUT, CHROME PLATED.
  - A KNURLED STEEL BEZEL, EITHER CHROME PLATED (FLS011) OR BLACK (FLS012).
- ASSEMBLE THE HARDWARE FROM EITHER THE FRONT OR REAR OF THE PANEL.
- INSTALL THROUGH A STANDARD 1/4 INCH DIAMETER HOLE; EITHER DRILLED OR PUNCHED, WITH NO CRITICAL TOLERANCES.
- ACCOMMODATES STANDARD T-1 3/4 LED LAMPS WITH .185 INCH TO .203 INCH BARREL DIAMETER. ALSO FITS TO-18 CASE LAMPS.
- FINGERS EASILY GRASP THE THICK KNURLED BEZEL.
- LARGE .062 INCH DIAMETER HOLES THROUGH THE BARREL ALLOW SOLDERED OR WIRE WRAPPED PINS TO PASS THROUGH.
- ADJUST TO ANY PANEL THICKNESS UP TO 3/16 INCH.
- FINE THREADS RESIST LOOSENING FROM VIBRATION.
- BLACK BEZEL OFFERS MAXIMUM ON/OFF CONTRAST RATIO.

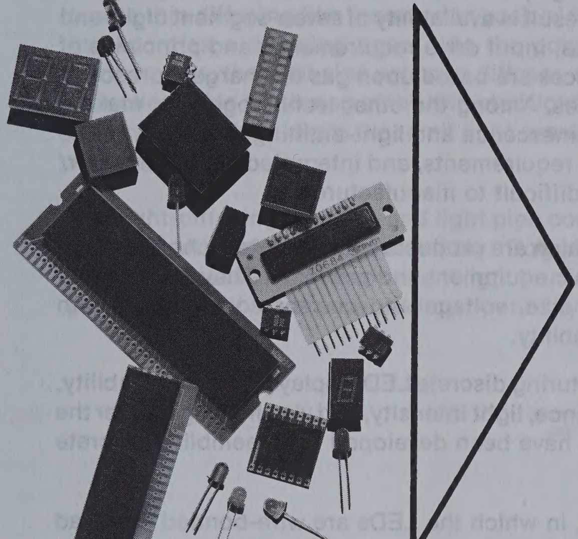
ORDERING INFORMATION:
For silver bezel retaining nut version, order FLS011. For black bezel retaining nut version, order FLS012.

MOUNTING OPTIONS





NOTE: .440 Dimension varies with LED used.



OPTOELECTRONIC TECHNOLOGY 1

DISCRETE LED DIGIT RELIABILITY 2

VISIBLE LED LAMPS AND MOUNTING HARDWARE 3

SEVEN-SEGMENT DISPLAYS AND DISPLAY ARRAYS 4

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CHAPTER 4
INTRODUCTION

Automation continues to demand better display readout devices for point-of-sale equipment, digital volmeters, and a multitude of other applications. Seven-segment-digit displays have become popular in large part because of their low cost, single-plane readout, and modern appearance. The result is availability of seven-segment digits and arrays in a wide variety of shapes, sizes, input drive requirements, and principles of operation. Most electronic readout devices are based upon gas discharge, florescent, incandescent, or solid state technologies. Among the other technologies for making seven-segment displays are electroluminescence and light-emitting thin films. These latter, however, have very high voltage requirements, and integrated circuit decoder/drivers for them are cumbersome and difficult to manufacture.

Light-emitting diode (LED) displays, which are products of solid state technology, are now found in a wide variety of electronic equipment and products. They have gained popularity because of their compact size, voltage and current compatibility with integrated circuits, and solid state reliability.

The primary considerations in manufacturing discrete LED display digits are reliability, ease of construction, quality of appearance, light intensity, and viewing angle. Over the last few years, three major techniques have been developed for assembling discrete LED digits.

The oldest technique is the filled digit, in which the LEDs are wire-bonded to a lead frame. A plastic cover with seven rectangular slots is placed over the lead frame and the entire assembly back filled with a red translucent diffused-plastic encapsulant. Another technique uses a printed circuit board instead of a lead frame to hold the LEDs, segment cover, and lens cap

The third approach is Fairchild's advanced air-filled light pipe process, a newer technique that combines the advantages of substantially lowered manufacturing costs with improved display intensity and appearance.

LED LIGHT PIPE DIGIT CONSTRUCTION

In the air-filled light pipe process, a lead frame provides mechanical support for, and makes electrical contact with, the LEDs that form each digit segment. After die attachment, the entire frame, or die platform, is placed in a mold and encapsulated with a clear optical-grade plastic. Magnifying lenses for the LEDs are cast in indentations in the mold surface.

After encapsulation, a reflector assembly, or light pipe, is placed over the die platform. Light pipes are injection molded from an acrylonitrile-butadiene-styrene (ABS) plastic that contains a reflective compound to increase the brightness of the display. The light pipe contains trapezoidal cavities, and is positioned so that the small ends of the cavities are situated directly over the LEDs and lenses. The larger top ends of the cavities have many times the surface area of the LEDs at the bottom. Finally, a lens cap is mounted over the die platform/light pipe assembly and the entire unit sealed. When one of the LEDs illuminates, light not only passes directly from the die, but is also reflected off the sidewalls of the cavity above it. The light is diffused by a diffusing agent in the lens cap and by the reflecting action of the light pipe. The net effect is that much more light reaches the viewer than would be emitted by a digit without a light pipe.

Regardless of manufacturing technique, all digits need a light-diffusing system to give segment an evenly lighted appearance. In filled digits, a diffusing chemical is mixed into the encapsulation, which then acts as the diffusing surface. Printed-circuit-board digits have a thin diffusing film mounted in back of the lens cap. The light pipe digit, however, incorporates a diffusing agent into the polycarbonate plastic of the lens cap itself. Furthermore, the light pipe acts as a diffuser, since it breaks up and scatters the light by reflection. This scattering of the reflected light, combined with the diffusing agent in the lens cap, results in digits that emit light evenly and pleasantly over the entire segment viewing area.

The light-diffusing lens cap and light pipe combination provides optimum light transmission while simplifying assembly. Polycarbonate was selected as the lens cap material because it offers excellent light transmission along with a high heat-deflection point, chemical resistance, and compatibility with the diffusing agent.

FAIRCHILD DISPLAY CROSS REFERENCE
KEY

COMPETITION:

HP	Hewlett-Packard
LIT	Litronix
MON	Monsanto
NAT	National
TI	Texas Instruments

COLOR:

A	Amber
G	Green
O	Orange
R	Red
Y	Yellow

POLARITY:

CC	Common Cathode
CA	Common Anode
U	Universal
M	Monolithic Display

DECIMAL:

RH	Right Hand
LH	Left Hand
C	Center Decimal
N	No Decimal

CODE:

NC-P	Not crossable because of package differences
NC-C	Not crossable because of color wavelength differences
NC-E	Not crossable because of electrical differences
A	Fairchild device is a direct replacement
B	Fairchild device is easily crossable with minor electrical differences as noted
C	Fairchild device is easily crossable with minor mechanical differences as noted
D	Significant electrical differences between devices as noted
E	Significant mechanical differences between devices as noted
W	Display array could be directly crossed with high volume order
X	Direct replacement to be introduced 1st quarter 1978.
Y	Direct replacement to be introduced 4th quarter 1977.

NOTES:

1	Fairchild device has different pinout.
2	Fairchild device has minor font differences on segments
3	Technology differences between devices (light pipe structure vs liquid filled segments)
4	Competitor device is 5 x 7 dot matrix
5	Competitor device has decimal point on opposite side as FSC.
6	Competitor device is .51" character height; FSC is .565" high.
7	Competitor device is .63" character height; FSC is .8" high.
8	Package thickness difference. Fairchild device is thicker.
9	Wired for direct drive: (ie: all segments brought out).
10	Wired for multiplexed: (ie: all segments tied together).
11	Competitor device is common anode. FSC device is common cathode
12	Competitor device uses super GaAsP die. FSC device has GaAsP die
13	Logic chip built into competitor device.
14	Only right hand decimal available on MAN72A device
15	No alarm indicator is on the Fairchild device
16	Minor mechanical spacing differences
17	Competitor device packaged in vinyl film. FSC device is in vial
18	Competitor device is waffle packed. FSC part is packed in vial.
19	Minor character height difference in die size

DEVICE CHARACTERISTICS

DEVICE	COMPETITOR	SIZE	COLOR	POLARITY	DESCRIPTION	DECIMAL	FAIRCHILD DEVICE	CODE	NOTES
HDSP-2000	HP	.3	R	M	4-Character Alphanumeric Dis.	N		NC-P	
5082-7010	HP	.27	R	M	Numeric Indicator	LH		NC-P	4
5082-7011	HP	.27	R	M	Overflow ± 1	N		NC-P	
5082-7100	HP	.27	R	M	3-Character Alphanumeric Dis.	N		NC-P	4
5082-7101	HP	.27	R	M	4-Character Alphanumeric Dis.	N		NC-P	4
5082-7102	HP	.27	R	M	5-Character Alphanumeric Dis.	N		NC-P	4
5082-7240	HP	.102	R	M	8-Digit Calculator Display	RH		NC-P	
5082-7241	HP	.102	R	M	9-Digit Calculator Display	RH		NC-P	
5082-7265	HP	.175	R	M	5-Digit Monolithic Indicators	C		NC-P	
5082-7275	HP	.175	R	M	15-Digit Monolithic Indicators	C		NC-P	
5082-7285	HP	.175	R	M	5-Digit Monolithic Indicators	RH		NC-P	
5082-7295	HP	.175	R	M	15-Digit Monolithic Indicators	RH		NC-P	
5082-7300	HP	.29	R	M	Numeric Indicator	RH		NC-P	
5082-7302	HP	.29	R	M	Numeric Indicator	RH		NC-P	
5082-7304	HP	.29	R	M	Overflow + 1 Indicator	N		NC-P	
5082-7340	HP	.29	R	M	Hexadecimal Indicator	N		NC-P	
5082-7356	HP	.29	R	M	Numeric Indicator	RH		NC-P	
5082-7357	HP	.29	R	M	Numeric Indicator	LH		NC-P	
5082-7358	HP	.29	R	M	Overflow + 1 Indicator	N		NC-P	
5082-7359	HP	.29	R	M	Hexadecimal Indicator	N		NC-P	
5082-7391	HP	.29	R	M	Numeric Indicator	RH		NC-P	
5082-7392	HP	.29	R	M	Numeric Indicator	LH		NC-P	
5082-7393	HP	.29	R	M	Overflow + 1	N		NC-P	
5082-7395	HP	.29	R	M	Hexadecimal Display	N		NC-P	
5082-7402	HP	.11	R	M	3-Digit Monolithic Display	C		NC-P	
5082-7403	HP	.11	R	M	3-Digit Monolithic Display	C		NC-P	
5082-7404	HP	.11	R	M	4-Digit Monolithic Display	C		NC-P	
5082-7405	HP	.11	R	M	5-Digit Monolithic Display	C		NC-P	
5082-7412	HP	.11	R	M	3-Digit Monolithic Display	RH		NC-P	
5082-7413	HP	.11	R	M	3-Digit Monolithic Display	RH		NC-P	
5082-7414	HP	.11	R	M	4-Digit Monolithic Display	RH		NC-P	
5082-7415	HP	.11	R	M	5-Digit Monolithic Display	RH		NC-P	
5082-7432	HP	.11	R	M	2-Digit Monolithic Display	N		NC-P	
5082-7433	HP	.11	R	M	3-Digit Monolithic Display	N		NC-P	
5082-7440	HP	.105	R	M	8-Digit Calculator Display	RH		NC-P	
5082-7441	HP	.105	R	M	9-Digit Calculator Display	RH		NC-P	
5082-7442	HP	.100	R	M	12-Digit Calculator Display	RH		NC-P	
5082-7444	HP	.100	R	M	14-Digit Calculator Display	RH		NC-P	
5082-7445	HP	.100	R	M	12-Digit Calculator Display	RH		NC-P	
5082-7446	HP	.115	R	M	16-Digit Calculator Display	RH		NC-P	
5082-7447	HP	.112	R	M	14-Digit Calculator Display	RH		NC-P	
5082-7448	HP	.105	R	M	8-Digit Calculator Display	RH		NC-P	
5082-7449	HP	.105	R	M	9-Digit Calculator Display	RH		NC-P	
5082-7500	HP	1.50	R	M	Numeric Indicator	LH		NC-P	4
5082-7610	HP	.3	R	CA	7-Segment Display	LH	MAN72A	B	12
5082-7611	HP	.3	R	CA	7-Segment Display	RH	MAN71A	B	12
5082-7613	HP	.3	R	CC	7-Segment Display	RH	MAN74A	Y	1,12
5082-7616	HP	.3	R	U	Overflow + 1	RH	MAN73A	X	1,12
5082-7620	HP	.3	Y	CA	7-Segment Display	LH		NC-C	
5082-7621	HP	.3	Y	CA	7-Segment Display	RH		NC-C	
5082-7623	HP	.3	Y	CC	7-Segment Display	RH		NC-C	
5082-7626	HP	.3	Y	U	Overflow + 1	RH		NC-C	
5082-7630	HP	.3	G	CA	7-Segment Display	LH		NC-C	
5082-7631	HP	.3	G	CA	7-Segment Display	RH		NC-C	
5082-7633	HP	.3	G	CC	7-Segment Display	RH		NC-C	
5082-7636	HP	.3	G	U	Overflow + 1	RH		NC-C	
5082-7650	HP	.43	R	CA	7-Segment Display	LH	FND567	B/E	1,3,5,12
5082-7651	HP	.43	R	CA	7-Segment Display	RH	FND567	B/E	1,3,12
5082-7653	HP	.43	R	CC	7-Segment Display	RH	FND560	B/E	1,3,12
5082-7656	HP	.43	R	U	Overflow + 1	RH	FND568	B/E	1,12,13
5082-7660	HP	.43	Y	CA	7-Segment Display	LH		NC-C	
5082-7661	HP	.43	Y	CA	7-Segment Display	RH		NC-C	
5082-7663	HP	.43	Y	CC	7-Segment Display	RH		NC-C	
5082-7666	HP	.43	Y	U	Overflow + 1	RH		NC-C	
5082-7670	HP	.43	G	CA	7-Segment Display	LH	FND537	E	1,3,5
5082-7671	HP	.43	G	CA	7-Segment Display	RH	FND537	E	1,3
5082-7673	HP	.43	G	CC	7-Segment Display	RH	FND530	E	1,3
5082-7676	HP	.43	G	U	Overflow + 1	RH	FND531	E	1,3
5082-7730	HP	.3	R	CA	7-Segment Display	LH	MAN72A	A	
5082-7731	HP	.3	R	CA	7-Segment Display	RH	MAN71A	A	
5082-7736	HP	.3	R	U	Overflow + 1	RH	MAN73A	X	1
5082-7740	HP	.3	R	CC	7-Segment Display	RH	MAN74A	X	1
5082-7750	HP	.43	R	CA	7-Segment Display	LH	FND507	E	1,3,5
5082-7751	HP	.43	R	CA	7-Segment Display	RH	FND507	E	1,3

DEVICE CHARACTERISTICS

DEVICE	COMPETITOR	SIZE	COLOR	POLARITY	DESCRIPTION	DECIMAL	FAIRCHILD DEVICE	CODE	NOTES
5082-7756	HP	.43	R	U	Overflow + 1	RH	FND501	E	1,3
5082-7760	HP	.43	R	CC	7-Segment Display	RH	FND500	E	1,3
5082-7811	HP	.053	R	M	7-Segment Monolithic Die	N	FNX8050	C	17
5082-7821	HP	.053	R	M	7-Segment Monolithic Die	N	FNX8050	C	18
5082-7832	HP	.080	R	M	7-Segment Monolithic Die	N	FNX8038	A	17
5082-7842	HP	.080	R	M	7-Segment Monolithic Die	N	FNX8038	A	18
5082-7851	HP	.100	R	M	7-Segment Monolithic Die	N	FNX8008	A	17
5082-7852	HP	.100	R	M	9-Segment Monolithic Die	N	FNX8009	A	17
5082-7853	HP	.100	R	M	1 or Colon Monolithic Die	N	FNX8012	A	17
5082-7861	HP	.100	R	M	7-Segment Monolithic Die	N	FNX8008	A	18
5082-7862	HP	.100	R	M	9-Segment Monolithic Die	N	FNX8009	A	18
5082-7863	HP	.100	R	M	1 or Colon Monolithic Die	N	FNX8012	A	18
5082-7871	HP	.120	R	M	7-Segment Monolithic Die	N	FNX8010	C	17,19
5082-7881	HP	.120	R	M	7-Segment Monolithic Die	N	FNX8010	C	18,19
5082-7890	HP	.011	R	M	Colon Monolithic Die	N	FLX2110	C	
5082-7892	HP	.011	R	M	Colon Monolithic Die	N	FLX2110	C	
DL 10	LIT	.27	R	CA	Monochromatic 7-Seg. Display	LH		NC-P	
DL 101	LIT	.27	R	CA	Monochromatic Overflow + 1	N		NC-P	
DL 10A	LIT	.27	R	CA	Monochromatic 7-Seg. Display	LH		NC-P	
DL 101A	LIT	.27	R	CA	Monochromatic Overflow + 1	N		NC-P	
DL 34M	LIT	.11	R	CC	Lensed Monolithic Display	RH		NC-P	
DL 44M	LIT	.15	R	CC	Lensed Monolithic Display	RH		NC-P	
DL 57	LIT	.32	R		Alpha-Numeric Display	LH		NC-P	4
DL 416	LIT	.160	R	CC	4-Digit Alpha-Numeric Display	N		NC-P	
DL 701	LIT	.3	R	CA	Overflow + 1	N	MAN73A	X	2
DL 702	LIT	.3	R	CC	7-Segment Display	LH	MAN74A	Y	2,5
DL 704	LIT	.3	R	CC	7-Segment Display	RH	MAN74A	Y	2
DL 707	LIT	.3	R	CA	7-Segment Display	LH	MAN72A	A	2
DL 707R	LIT	.3	R	CA	7-Segment Display	RH	MAN71A	A	2
DL 721	LIT	.5	R	CA	1 1/2-Digit, 7-Segment Display	RH	FND6730	E	1,2,6
DL 722	LIT	.5	R	CC	1 1/2-Digit, 7-Segment Display	RH	FND6750	E	1,2,6
DL 727	LIT	.5	R	CA	Dual Digit, 7-Segment Display	RH	FND6710	C	2,6
DL 728	LIT	.5	R	CC	Dual Digit, 7-Segment Display	RH	FND6740	C	2,6
DL 740	LIT	.63	R	CA	Overflow + 1	N		NC-P	
DL 741	LIT	.63	R	CA	7-Segment Display	LH	FND847	C	2,3,7,8
DL 746	LIT	.63	R	CA	Overflow + 1	N		NC-P	
DL 747	LIT	.63	R	CA	7-Segment Display	LH	FND847	C	2,3,7,8
DL 749	LIT	.63	R	CC	Overflow + 1	N		NC-P	
DL 750	LIT	.63	R	CC	7-Segment Display	LH	FND850	C	2,3,7,8
DL 751	LIT	.63	R	CC	7-Segment Display	LH	FND850	C	2,3,7,8
DL 752	LIT	.63	R	CC	Overflow + 1	N		NC-P	
DL 3531	LIT	.5	R	CA	3 1/2-Digit Display Array	RH	FNA5421	E	1,2,10,11
DL 4120	LIT	1.0	R	CC	4-Digit Clock Display Array	RH	FCS8024	E	1,2,9
DL 4500	LIT	.5	R	CC	4-Digit Clock Display Array	N		NC-P	2,10
DL 4520A	LIT	.5	R	CC	4-Digit Clock Display Array	N	FCS5599	E	1,2,9
DL 4530	LIT	.5	R	CA	4-Digit Display Array	RH	FNA5420	E	1,2,10,11
DL 5175	LIT	.102	R	M	Monolithic Watch Displays	N		NC-P	
DL 5179	LIT	.105	R	M	Monolithic Watch Displays	N		NC-P	
MAN 1	MON	.27	R	CA	Monochromatic 7-Seg. Display	LH		NC-P	
MAN 1A	MON	.27	R	CA	Monochromatic 7-Seg. Display	LH		NC-P	
MAN 2A	MON	.32	R		Alpha-Numeric Display	LH		NC-P	4
MAN 10	MON	.27	R	CA	Monochromatic 7-Seg. Display	LH		NC-P	
MAN 10A	MON	.27	R	CA	Monochromatic 7-Seg. Display	LH		NC-P	
MAN 51A	MON	.3	G	CA	7-Segment Display	RH		NC-C	
MAN 52A	MON	.3	G	CA	7-Segment Display	LH		NC-C	
MAN 53A	MON	.3	G	CA	Overflow + 1	N		NC-C	
MAN 54A	MON	.3	G	CC	7-Segment Display	RH		NC-C	
MAN 71A	MON	.3	R	CA	7-Segment Display	RH	MAN71A	A	2
MAN 72A	MON	.3	R	CA	7-Segment Display	LH	MAN72A	A	2
MAN 73A	MON	.3	R	CA	Overflow + 1	N	MAN73A	X	2
MAN 74A	MON	.3	R	CC	7-Segment Display	RH	MAN74A	Y	2
MAN 81A	MON	.3	Y	CA	7-Segment Display	RH		NC-C	
MAN 82A	MON	.3	Y	CA	7-Segment Display	LH		NC-C	
MAN 83A	MON	.3	Y	CA	Overflow + 1	N		NC-C	
MAN 84A	MON	.3	Y	CC	7-Segment Display	RH		NC-C	
MAN 1001	MON	.27	R	CA	Monochromatic Overflow + 1	N		NC-P	
MAN 1001A	MON	.27	R	CA	Monochromatic Overflow + 1	N		NC-P	
MAN 101	MON	.27	R	CA	Monochromatic Overflow + 1	N		NC-P	
MAN 101A	MON	.27	R	CA	Monochromatic Overflow + 1	N		NC-P	
MAN 3610A	MON	.3	O	CA	7-Segment Display	RH	MAN3610A	X	2
MAN 3620A	MON	.3	O	CA	7-Segment Display	LH	MAN3620A	X	2
MAN 3630A	MON	.3	O	CA	Overflow + 1	N	MAN3630A	X	2
MAN 3640A	MON	.3	O	CC	7-Segment Display	RH	MAN3640A	X	2
MAN 4610A	MON	.4	O	CA	7-Segment Display	RH	FND558	E	1,2,3

DEVICE CHARACTERISTICS

DEVICE	COMPETITOR	SIZE	COLOR	POLARITY	DESCRIPTION	DECIMAL	FAIRCHILD DEVICE	CODE	NOTES
MAN 4630A	MON	.4	O	CA	Overflow + 1	RH	FND557	E	1,2,3
MAN 4640A	MON	.4	O	CC	7-Segment Display	RH	FND550	E	1,2,3
MAN 6610	MON	.56	O	CA	Dual Digit, 7-Segment Display	RH	FND6710	X	2
MAN 6630	MON	.56	O	CA	1 1/2-Digit, 7-Segment Display	RH	FND6730	X	2
MAN 6640	MON	.56	O	CC	Dual Digit, 7-Segment Display	RH	FND6740	X	2
MAN 6650	MON	.56	O	CC	1 1/2-Digit, 7-Segment Display	RH	FND6750	X	2
MAN 6660	MON	.56	O	CA	Single Display, 7-Seg. Display	RH		NC-P	
MAN 6680	MON	.56	O	CC	Single Display, 7-Seg. Display	RH		NC-P	
MAN 6710	MON	.56	R	CA	Dual Digit, 7-Segment Display	RH	FND6710	A	2
MAN 6730	MON	.56	R	CA	1 1/2 Digit, 7-Segment Display	RH	FND6730	A	2
MAN 6740	MON	.56	R	CC	Dual Digit, 7-Segment Display	RH	FND6740	A	2
MAN 6750	MON	.56	R	CC	1 1/2-Digit, 7-Segment Display	RH	FND6750	A	2
NSN 334	NAT	.3	R	CA	1 1/2-Digit Display Array	RH		W	9
NSN 373	NAT	.3	R	CC	2-Digit Display Array	RH		W	9
NSN 374	NAT	.3	R	CA	2-Digit Display Array	RH		W	9
NSN 381	NAT	.3	R	CC	2-Digit Display Array	RH		W	10
NSN 382	NAT	.3	R	CA	2-Digit Display Array	RH		W	10
NSN 534	NAT	.5	R	CA	1 1/2-Digit Display Array	RH		W	9
NSN 581	NAT	.5	R	CC	2-Digit Display Array	RH		W	10
NSN 582	NAT	.5	R	CA	2-Digit Display Array	RH		W	10
NSN 583	NAT	.5	R	CC	2-Digit Display Array	RH		W	9
NSN 584	NAT	.5	R	CA	2-Digit Display Array	RH		W	9
NSN 734	NAT	.7	R	CA	1 1/2-Digit Display Array	RH		W	9
NSN 781	NAT	.7	R	CC	2-Digit Display Array	RH		W	10
NSN 782	NAT	.7	R	CA	2-Digit Display Array	RH		W	10
NSN 783	NAT	.7	R	CC	2-Digit Display Array	RH		W	9
NSN 784	NAT	.7	R	CA	2-Digit Display Array	RH		W	9
NSB 3382	NAT	.3	R	CA	3 1/2-Digit Display Array	RH		W	10
NSB 3881	NAT	.3	R	CC	4-Digit Display Array	RH	FNA3420	C	1,10
NSB 3882	NAT	.3	R	CA	4-Digit Display Array	RH	FNA3420	E	1,10
NSB 5382	NAT	.5	R	CA	3 1/2-Digit Display Array	RH	FNA5421	E	1,10
NSB 5881	NAT	.5	R	CC	4-Digit Display Array	RH	FNA5420	C	1,10
NSB 5882	NAT	.5	R	CA	4-Digit Display Array	RH	FNA5420	E	1,10
NSB 5917	NAT	.5	R	CA	4 1/2-Digit Display Array	RH	FNA5521	E	1,10
NSB 5921	NAT	.5	R	CC	5-Digit Display Array	RH	FNA5520	C	1,10
NSB 5922	NAT	.5	R	CA	5-Digit Display Array	RH	FNA5520	E	1,10
NSB 7382	NAT	.7	R	CA	3 1/2-Digit Display Array	RH		W	10
NSB 7881	NAT	.7	R	CC	4-Digit Display Array	RH		W	10
NSB 7882	NAT	.7	R	CA	4-Digit Display Array	RH		W	10
NSC 0014	NAT		R		Decimal Pt. Monolithic Die	N	FLX2110	C	19
NSW 3101	NAT		R		Full Colon Monolithic Die	N	FNX8099	A	
NSW 9060	NAT	.060	R		9-Segment Monolithic Display			NC-P	
NSW 9070	NAT	.070	R		9-Segment Monolithic Display			NC-P	
NSW 9075	NAT	.075	R		9-Segment Monolithic Display			NC-P	
NSW 1080	NAT	.080	R		11-Segment Monolithic Display			NC-P	
NSW 1090	NAT	.090	R		11-Segment Monolithic Display			NC-P	
NSW 9100	NAT	.101	R		9-Segment Monolithic Display		FNX8009	A	
NSW 1116	NAT	.116	R		9-Segment Monolithic Display		FNX8019	A	
TIL 302	TI	.27	R	CA	Monochromatic 7-Seg. Display	LH		NC-P	
TIL 303	TI	.27	R	CA	Monochromatic 7-Seg. Display	RH		NC-P	
TIL 304	TI	.27	R	CA	Monochromatic Overflow + 1			NC-P	
TIL 305	TI	.3	R		Alpha-Numeric Display	LH		NC-P	4
TIL 306	TI	.27	R		Monochromatic 7-Seg. Display	LH		NC-P	13
TIL 307	TI	.27	R		Monochromatic 7-Seg. Display	LH		NC-P	13
TIL 308	TI	.27	R		Monochromatic 7-Seg. Display	LH		NC-P	13
TIL 309	TI	.27	R		Monochromatic 7-Seg. Display	RH		NC-P	13
TIL 311	TI	.3	R		Hexadecimal Display	BS		NC-P	13
TIL 312	TI	.3	R	CA	7-Segment Display	BS	MAN72A	B	14
TIL 313	TI	.3	R	CC	7-Segment Display	RH	MAN74A	Y	1
TIL 314	TI	.3	G	CA	7-Segment Display	BS		NC-C	
TIL 315	TI	.3	G	CC	7-Segment Display	RH		NC-C	
TIL 316	TI	.3	A	CA	7-Segment Display	BS		NC-C	
TIL 317	TI	.3	A	CC	7-Segment Display	RH		NC-C	
TIL 321	TI	.5	R	CA	7-Segment Display	RH	FND507	A	
TIL 322	TI	.5	R	CC	7-Segment Display	RH	FND500	A	
TIL 323	TI	.5	G	CA	7-Segment Display	RH	FND537	A	
TIL 324	TI	.5	G	CC	7-Segment Display	RH	FND530	A	
TIL 325	TI	.5	A	CA	7-Segment Display	RH	FND557	A	
TIL 326	TI	.5	A	CC	7-Segment Display	RH	FND550	A	
TIL 327	TI	.3	R	CA	Overflow + 1	LH	MAN73A	Y	1
TIL 328	TI	.3	G	CA	Overflow + 1	LH		NC-C	
TIL 329	TI	.3	A	CA	Overflow + 1	LH		NC-C	
TIL 330	TI	.5	R	CA	Overflow + 1	RH	FND508	A	
TIL 331	TI	.5	G	CA	Overflow + 1	RH	FND538	A	

DEVICE CHARACTERISTICS

DEVICE	COMPETITOR	SIZE	COLOR	POLARITY	DESCRIPTION	DECIMAL	FAIRCHILD DEVICE	CODE	NOTES
TIL 332	TI	.5	A	CA	Overflow + 1	RH	FND558	A	
TIL 360	TI	.1	R		6-Digit, 7-Segment Display	RH		NC-P	
TIL 361	TI	.5	R	CC	2-Digit, 7-Segment Display	N	FNA5220	C	1
TIL 362	TI	.5	G	CC	2-Digit, 7-Segment Display	N		NC-C	
TIL 363	TI	.5	A	CC	2-Digit, 7-Segment Display	N		NC-C	
TIL 364	TI	.5	R	CC	3 1/2-Digit, Clock Display	N	FCS5599	E	1,15,16
TIL 365	TI	.5	G	CC	3 1/2-Digit, Clock Display	N		NC-C	
TIL 366	TI	.5	A	CC	3 1/2-Digit, Clock Display	N		NC-C	
TIL 367	TI	.5	R	CC	3 1/2-Digit, Clock Display	N	FCS5599	C	1,16
TIL 368	TI	.5	G	CC	3 1/2-Digit, Clock Display	N		NC-C	
TIL 369	TI	.5	A	CC	3 1/2-Digit, Clock Display	N		NC-C	
TIL 370	TI	.5	R	CC	4-Digit, Clock Display	N	FCS5599	E	1,15,16
TIL 371	TI	.5	G	CC	4-Digit, Clock Display	N		NC-C	
TIL 372	TI	.5	A	CC	4-Digit, Clock Display	N		NC-C	
TIL 373	TI	.5	R	CC	4-Digit, Clock Display	N	FCS5599	C	1,16
TIL 374	TI	.5	C	CC	4-Digit, Clock Display	N		NC-C	
TIL 375	TI	.5	A	CC	4-Digit, Clock Display	N		NC-C	
TIL 379-12	TI	.106	R		12-Digit, Monolithic Display	RH		NC-P	
TIL 380-8	TI	.110	R		8-Digit, Monolithic Display	RH		NC-P	
TIL 380-9	TI	.110	R		9-Digit, Monolithic Display	RH		NC-P	
TIL 382	TI	.100	R		4-Digit Watch Displays	N			
TIL 383	TI	.100	R		4-Digit Watch Displays	N			
TIL 384	TI	.116	R		4-Digit Watch Displays	N			
TIL 385	TI	.116	R		4-Digit Watch Displays	N			
TIL 392-6	TI	.102	R		6-Digit Calculator Display	RH		NC-P	
TIL 392-8	TI	.102	R		8-Digit Calculator Display	RH		NC-P	
TIL 392-9	TI	.102	R		9-Digit Calculator Display	RH		NC-P	
TIL 393-6	TI	.102	R		6-Digit Calculator Display	RH		NC-P	
TIL 393-8	TI	.102	R		8-Digit Calculator Display	RH		NC-P	
TIL 393-9	TI	.102	R		9-Digit Calculator Display	RH		NC-P	
TIL 394-8	TI	.110	R		8-Digit Calculator Display	RH		NC-P	
TIL 394-9	TI	.110	R		9-Digit Calculator Display	RH		NC-P	
TIL 396	TI	.100	R		4-Digit Watch Display	N			
TIL 397	TI	.100	R		4-Digit Watch Display	N			
TIL 398	TI	.100	R		4-Digit Watch Display	N			
TIL 399	TI	.100	R		4-Digit Watch Display	N			

FCS6400 • FCS6401

RED GaAsP 0.6" 3 1/2 AND 4-DIGIT LED CLOCK DISPLAYS

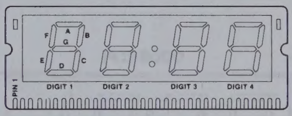
OPTOELECTRONICS PRODUCT GROUP

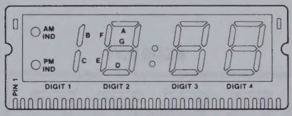
GENERAL DESCRIPTION — The FCS6400 (4-digit) and FCS6401 (3 1/2-digit) are common cathode, solid state numeric display modules. The FCS6401 display incorporates AM and PM indication for use in 12 hour operating mode.

All modules are compact and mounted on a board for easy insertion, allowing maximum flexibility to the end user. Their red faceplates combine high contrast with clean, simple appearance.

- **PIN COMPATIBLE WITH TOSHIBA TLR2047/TLR4040**
- **LOW DRIVE CURRENT REQUIREMENTS**
- **IC COMPATIBLE**
- **COMPACT THIN PACKAGE, EASILY INCORPORATED IN THE SYSTEM**
- **PC BOARD TYPE TERMINALS ALLOW EASY CONNECTION BY WIRE OR PIN SOLDERING OR WITH CARD-EDGE CONNECTOR**
- **WIDE VIEWING ANGLE WITH HIGH CONTRAST RED FACEPLATE**
- **APPLICATIONS INCLUDE WALL CLOCKS, DESK CLOCKS, CLOCK RADIOS INTERVAL TIMERS**
- **COMMON CATHODE DIRECT DRIVE**

PIN CONNECTIONS





ABSOLUTE MAXIMUM RATINGS

Maximum Temperatures

Storage Temperature	-20°C to +75°C
Operating Temperature	-20°C to +75°C
Pin Temperature (Soldering, 3 s at 1.5 mm from seating plane)	260°C

Maximum Voltages and Currents

V_R	Reverse Voltage	3.0 V
$I_{F(Avg)}$	Average Forward Current (segment or decimal)	20 mA
I_{pk}	Peak Current (segment or decimal)	60 mA

ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

SYMBOL	CHARACTERISTICS	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.9	2.1	V	I_F = 10.0 mA/Segment
I_λ	Average Luminous Intensity per Segment	0.08	0.20		mcd	I_F = 10.0 mA/Segment
ΔI	Intensity Matching (Note 1)			3		I_F = 10.0 mA/Segment
λ_{pk}	Peak Wavelength		665		nm	
$\Delta\lambda$	Spectral Line Half-Width		25		nm	
θ	Viewing Angle		±30		degrees	

(Note 1: Segment to Segment from average Segment intensity)

PIN ASSIGNMENT

FC6400

1	Com. Cath. Digits 1 & 2	18	Colon Anode
2	N/C	19	Colon Anode
3	N/C	20	Segment F3 Anode
4	Segment A1 Anode	21	Segment G3 Anode
5	Segment F1 Anode	22	Segment A3 Anode
6	Segment G1 Anode	23	Segment B3 Anode
7	Segment E1 Anode	24	Segment D3 Anode
8	Segment D1 Anode	25	Segment E3 Anode
9	Segment C1 Anode	26	Segment C3 Anode
10	Segment B1 Anode	27	Segment F4 Anode
11	Segment F2 Anode	28	Segment G4 Anode
12	Segment G2 Anode	29	Segment A4 Anode
13	Segment A2 Anode	30	Segment B4 Anode
14	Segment B2 Anode	31	Segment E4 Anode
15	Segment E2 Anode	32	Segment D4 Anode
16	Segment D2 Anode	33	Segment C4 Anode
17	Segment C2 Anode	34	Com. Cath. Digits 3 & 4

FC6401

1	Com. Cath. Digits 1 & 2	18	Colon Anode
2	PM IND. Anode	19	Colon Anode
3	AM IND.	20	Segment F3 Anode
4	N/C	21	Segment G3 Anode
5	N/C	22	Segment A3 Anode
6	N/C	23	Segment B3 Anode
7	N/C	24	Segment D3 Anode
8	N/C	25	Segment E3 Anode
9	Segment C1 Anode	26	Segment C3 Anode
10	Segment B1 Anode	27	Segment F4 Anode
11	Segment F2 Anode	28	Segment G4 Anode
12	Segment G2 Anode	29	Segment A4 Anode
13	Segment A2 Anode	30	Segment B4 Anode
14	Segment B2 Anode	31	Segment E4 Anode
15	Segment E2 Anode	32	Segment D4 Anode
16	Segment D2 Anode	33	Segment C4 Anode
17	Segment C2 Anode	34	Com. Cath. Digits 3 & 4

FCS8000 • FCS8024

RED GaAsP 0.8" 3 1/2 AND 4 DIGIT LED CLOCK DISPLAYS

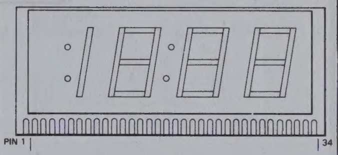
OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION — The FCS8000 is a 3-1/2 digit, common-cathode, solid state numeric display module. It includes an AM-PM indicator and pinouts compatible with the Fairchild 3817 MOS clock circuit. The FCS8024 is a 4-digit, common-cathode version for European format. Standard interface circuits will allow operation with TTL, DTL, or CMOS SSI and MSI circuits.

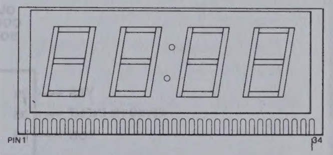
All modules are compact and mounted on a board for easy insertion, allowing maximum flexibility to the end user. Their red faceplates combine high contrast with clean, simple appearance.

CONNECTION DIAGRAMS

FCS8000



FCS8024



- IC COMPATIBLE WITH SIMPLE INTERFACE CIRCUITS
- COMPACT THIN 0.47 INCH PACKAGE, EASILY INCORPORATED IN THE SYSTEM
- PC BOARD TYPE TERMINALS ALLOW EASY CONNECTION BY WIRE OR PIN SOLDERING OR WITH CARD-EDGE CONNECTOR
- WIDE VIEWING ANGLE WITH HIGH CONTRAST RED FACEPLATE
- LOW POWER TYPICALLY 8 mA PER SEGMENT AVERAGE AT ONLY 1.8 V
- APPLICATIONS INCLUDE WALL CLOCKS, DESK CLOCKS, CLOCK RADIOS INTERVAL TIMERS
- COMMON-CATHODE FOR EASY DRIVING

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	−40°C to +80°C
Operating Temperature	−40°C to +80°C
Pin Temperature (Soldering, 5 s)	230°C
Relative Humidity at 60°C	90%

Maximum Voltages and Currents

V_R	Reverse Voltage	3.0 V
I_F (Avg)	Average Forward Current (Segment or Decimal)	20 mA
I_{pk}	Peak Current (Segment or Decimal)	60 mA

ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.65		V	I_F = 8.0 mA/Segment
I_λ	Average Luminous Intensity per Segment		350		μcd	I_F = 8.0 mA/Segment
ΔI_λ	Intensity Matching (Note 1)		±33		%	I_F = 8.0 mA/Segment
λ_{pk}	Peak Wavelength		660		nm	
$\Delta\lambda$	Spectral Line Half-Width		25		nm	
$\theta_{1/2}$	Viewing Angle at Half Intensity		> ±30		degrees	

PIN NAMES

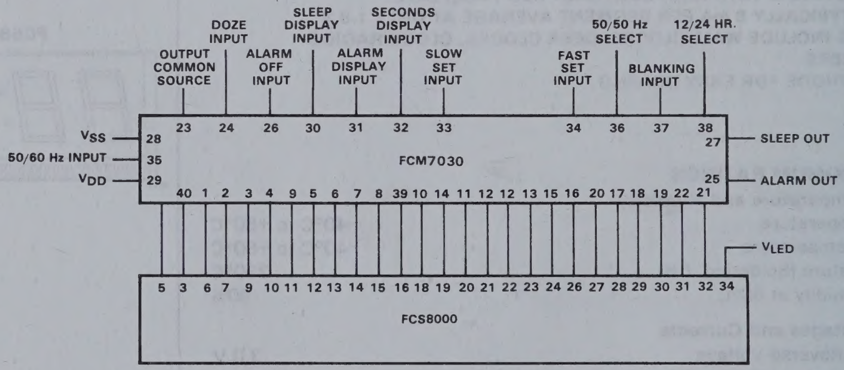
FCS8000

Pin No.	Segment	Pin No.	Segment
1	NC	18	10 Min. F
2	NC	19	10 Min. E
3	Indicator	20	10 Min. G
4	NC	21	10 Min. A
5	Indicator	22	10 Min. D
6	10 Hrs. C	23	10 Min. B
7	10 Hrs. B	24	10 Min. C
8	NC	25	NC
9	Hrs. F	26	Min. F
10	Hrs. G	27	Min. E
11	Hrs. E	28	Min. G
12	Hrs. A	29	Min. A
13	Hrs. B	30	Min. B
14	Hrs. D	31	Min. C
15	Hrs. C	32	Min. D
16	Colons	33	NC
17	NC	34	V_{LED}

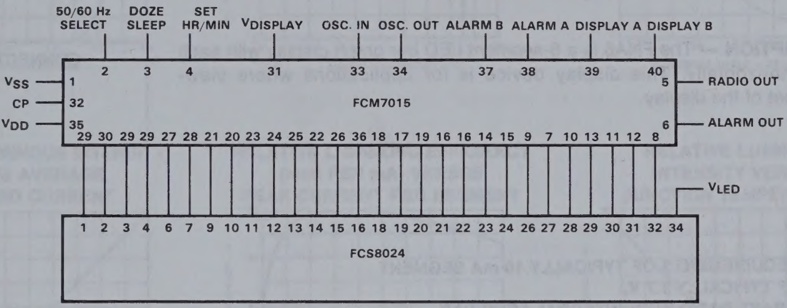
FCS8024

Pin No.	Segment	Pin No.	Segment
1	10 Hrs. A	18	10 Min. F
2	10 Hrs. E	19	10 Min. E
3	10 Hrs. D	20	10 Min. G
4	10 Hrs. G	21	10 Min. A
5	10 Hrs. F	22	10 Min. D
6	10 Hrs. C	23	10 Min. B
7	10 Hrs. B	24	10 Min. C
8	NC	25	NC
9	Hrs. F	26	Min. F
10	Hrs. G	27	Min. E
11	Hrs. E	28	Min. G
12	Hrs. A	29	Min. A
13	Hrs. B	30	Min. B
14	Hrs. D	31	Min. C
15	Hrs. C	32	Min. D
16	Colons	33	NC
17	NC	34	V_{LED}

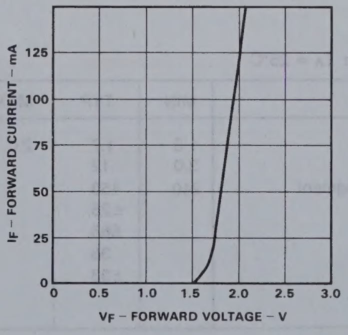
FCS8000 • FCS8001 BLOCK DIAGRAM


DOZE INPUT
SLEEP DISPLAY INPUT
SECONDS DISPLAY INPUT
50/50 Hz SELECT
12/24 HR. SELECT
OUTPUT COMMON SOURCE
ALARM OFF INPUT
ALARM DISPLAY INPUT
SLOW SET INPUT
FAST SET INPUT
BLANKING INPUT
23 24 26 30 31 32 33 34 36 37 38
VSS 28
50/60 Hz INPUT 35
VDD 29
FCM7030
27 SLEEP OUT
25 ALARM OUT
40 1 2 3 4 9 5 6 7 8 39 10 14 11 12 12 13 15 16 20 17 18 19 22 21
VLED
5 3 6 7 9 10 11 12 13 14 15 16 18 19 20 21 22 23 24 26 27 28 29 30 31 32 34
FCS8000

FCS8024 • FCS8025 BLOCK DIAGRAM


50/60 Hz SELECT
DOZE SLEEP
SET HR/MIN
V_DISPLAY
OSC. IN
OSC. OUT
ALARM B
ALARM A
DISPLAY A
DISPLAY B
2 3 4 31 33 34 37 38 39 40
V_SS 1
CP 32
V_DD 35
5 RADIO OUT
6 ALARM OUT
FCM7015
29 30 29 29 27 28 21 20 23 24 25 22 26 36 18 17 19 16 16 14 15 9 7 10 13 11 12 8
V_LED
1 2 3 4 6 7 9 10 11 12 13 14 15 16 18 19 20 21 22 23 24 26 27 28 29 30 31 32 34
FCS8024

FORWARD CURRENT VERSUS FORWARD VOLTAGE (T_J)



FNA6

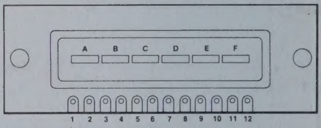
RED GaAsP 6-SEGMENT LED BAR GRAPH DISPLAY

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION — The FNA6 is a 6-segment LED bar graph display with each segment aligned horizontally. This display device is for applications where viewing is within thirty feet of the display.

- **LOW CURRENT REQUIREMENTS OF TYPICALLY 10 mA SEGMENT**
- **LOW VOLTAGE OF TYPICALLY 1.7 V_F**
- **MAXIMIZED CONTRAST RATIO WITH INTEGRAL LENS CAP**
- **EACH LED HAS COMMON-ANODE AND COMMON-CATHODE.**

CONNECTION DIAGRAM



PIN

1	Segment A cathode
2	Segment A anode
3	Segment B cathode
4	Segment B anode
5	Segment C cathode
6	Segment C anode
7	Segment D cathode
8	Segment D anode
9	Segment E cathode
10	Segment E anode
11	Segment F cathode
12	Segment F anode

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Operating Temperature	−25°C to +85°C
Storage Temperature	−25°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 60°C	90%

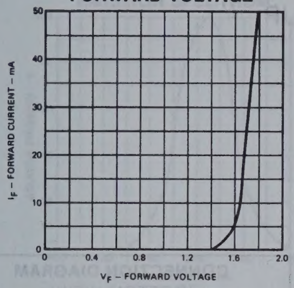
Maximum Voltage and Currents

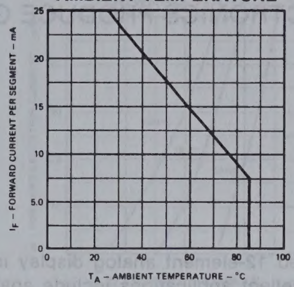
V_R	Reverse Voltage	3.0V
$I_{F(AVG)}$	Average Forward Current/Segment or Decimal Point	25 mA
	Derate from 25°C Ambient Temperature (Fig. 2)	.03 mA/°C
i_f	Peak Forward Current/Segment or Decimal Point (100 μs pulse width) pps, T_A = 25°C	200 mA

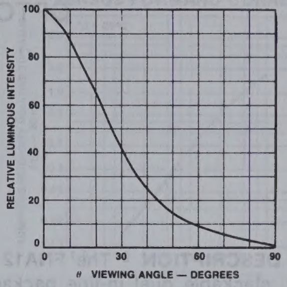
ELECTRICAL AND RADIANT CHARACTERISTICS: T_A = 25°C

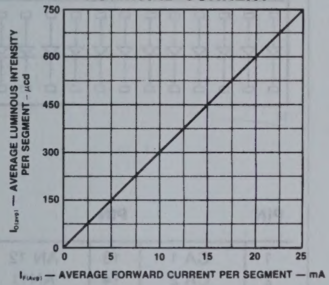
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage	1.5	1.7	2.0	V	I_F = 20 mA
BV_R	Reverse Breakdown Voltage	3.0	12		V	I_R = 1.0 mA
I_O	Axial Luminous Intensity, Each Segment	240	450		μcd	I_F = 20 mA
$\theta½$	Viewing Angle to Half Intensity		±25		degrees	
λ_{pk}	Peak Wavelength		665		nm	I_F = 20 mA
L_O	Average Segment Luminance		35		ftL	I_F = 20 mA
ΔI_O	Intensity Matching, Segment to Segment		±33		%	I_F = 20 mA

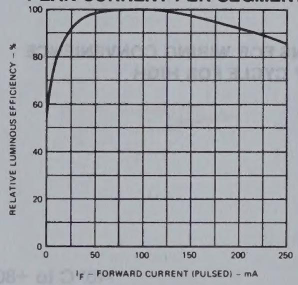
TYPICAL CHARACTERISTICS CURVES

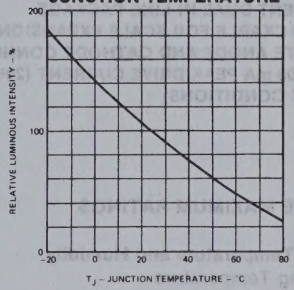

FORWARD CURRENT VERSUS FORWARD VOLTAGE


MAXIMUM AVERAGE CURRENT RATING VERSUS AMBIENT TEMPERATURE


ANGULAR DISTRIBUTION OF LUMINOUS INTENSITY


AVERAGE LUMINOUS INTENSITY VERSUS AVERAGE FORWARD CURRENT


RELATIVE LUMINOUS EFFICIENCY (mcd PER mA) VERSUS PEAK CURRENT PER SEGMENT


RELATIVE LUMINOUS INTENSITY VERSUS JUNCTION TEMPERATURE

FNA12

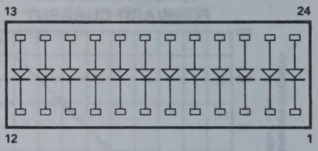
12-ELEMENT BAR DISPLAY

OPTOELECTRONICS PRODUCE GROUP

GENERAL DESCRIPTION - The FNA12 is a red 12-element analog display in a convenient, stackable dual in-line package. Excellent applications include analog meter readouts, radio frequency indicator, or computer register displays.

- **12-ELEMENT DUAL IN-LINE PACKAGE**
- **END-STACKABLE FOR SCALE EXPANSION**
- **SEPARATE ANODE AND CATHODE CONNECTIONS FOR WIRING CONVENIENCE**
- **UP TO 100 mA PEAK DRIVE CURRENT (20% DUTY CYCLE FOR HIGH AMBIENT CONDITIONS)**

CONNECTION DIAGRAM
(BOTTOM VIEW)



PIN		PIN	
1	CA 1	13	AN 12
2	CA 2	14	AN11
3	CA 3	15	AN 10
4	CA 4	16	AN 9
5	CA 5	17	AN 8
6	CA 6	18	AN 7
7	CA 7	19	AN 6
8	CA 8	20	AN 5
9	CA 9	21	AN 4
10	CA 10	22	AN 3
11	CA 11	23	AN 2
12	CA 12	24	AN 1

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Operating Temperature	-40° C to +80° C
Storage Temperature	-40° C to +80° C
Pin Temperature (Soldering, 5 s)	230° C
Relative Humidity at 85° C	85%

Maximum Power Dissipation

Total Dissipation at $T_A = 25°C$	100 mW
Derate Linearly from 25° C	1.33 mW/° C

Maximum Voltage and Currents

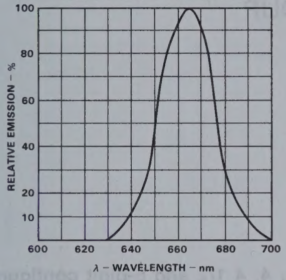
V_R	Reverse Voltage	3.0 V
I_F	Average Forward Current per element	20 mA
i_f	Peak Forward Current (1.0 μs pulse width)	1.0 A

ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

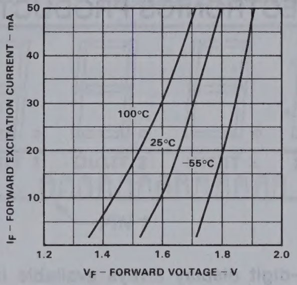
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.6	2.0	V	I_F = 20 mA/seg
V_R	Reverse Voltage	3.0			V	I_R = 100 μA
I_O	Axial Luminous Intensity	60 100	100 200		μcd μcd	I_F = 6 mA/seg I_F = 10mA
λpk	Peak Wavelength		665		nm	I_F = 20 mA/seg
ΔI	Intensity Matching Maximum Variation		±33		%	

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

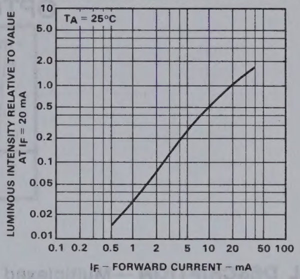
EMISSION SPECTRUM



FORWARD CURRENT VERSUS FORWARD VOLTAGE



RELATIVE LUMINOUS INTENSITY VERSUS FORWARD CURRENT



FNA5400 • FNA5500 SERIES
MULTI-DIGIT DISPLAY ARRAYS
OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION — Multiplexed multi-digit display arrays available in 3 1/2, 4, 4 1/2 and 5-digit configurations in common-cathode version for use in digital meters, P.O.S. terminals, and other multiple digit applications.

- **HALF-INCH TALL DISPLAYS**
- **DISPLAYS STACKABLE ON .575 INCH CENTERS**
- **MULTIPLEXED OPERATION**
- **DECIMAL POINT TO THE RIGHT OF EACH DIGIT**
- **COMMON CATHODE**
- **LOW VOLTAGE - V_F TYPICALLY 1.7V**

DEVICE DESCRIPTION

FUNCTION	COMMON-CATHODE
3 1/2 Digit Plus Overflow	FNA5421
4 Digit	FNA5420
4 1/2 Digit Plus Overflow	FNA5521
5 Digit	FNA5520

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	-25° C to +85° C
Operating Temperature	-25° C to +85° C
Pin Temperature (Soldering 5s)	260° C
Relative Humidity at 60° C	90%

MAXIMUM VOLTAGE AND CURRENTS

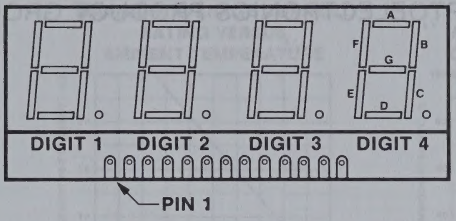
V_R	Reverse Voltage	3.0V
I_F (Avg)	Average Forward Current (Segment or Decimal Points)	20 mA
i_f	Peak Forward Current (Segment or Decimal Points)	200 mA

ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

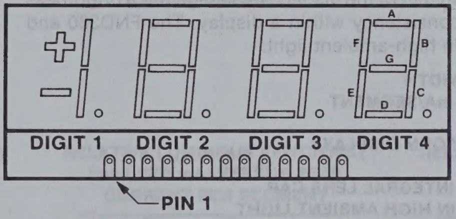
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage	1.5	1.7	2.0	V	I_F = 20 mA
BV_R	Reverse Breakdown Voltage	3.0	1.2		V	I_R = 1.0 mA
I_O	Axial Luminous Intensity, Each Segment	300	600		μcd	I_F = 20 mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		±25		degrees	
λ_{pk}	Peak Wavelength		650		nm	I_F = 20 mA
L_O	Average Segment Luminance		35		ftL	I_F = 20 mA
ΔI_O	Intensity Matching Segment to Segment		±33		%	I_F = 20 mA

PIN ASSIGNMENTS

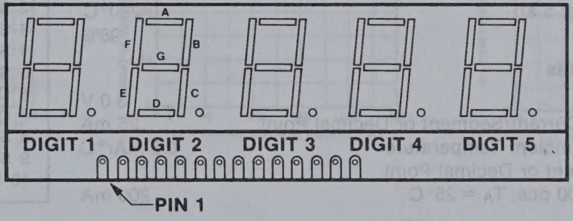
FNA5420/27


A
F
B
G
E
C
D
DIGIT 1
DIGIT 2
DIGIT 3
DIGIT 4
PIN 1

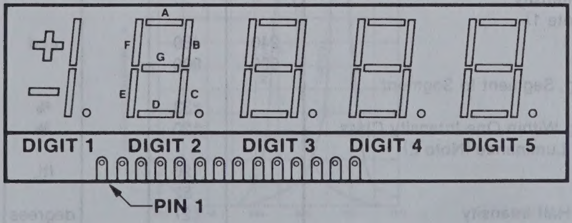
FNA5421/28


A
F
B
G
E
C
D
DIGIT 1
DIGIT 2
DIGIT 3
DIGIT 4
PIN 1

FNA5520/27


A
F
B
G
E
C
D
DIGIT 1
DIGIT 2
DIGIT 3
DIGIT 4
DIGIT 5
PIN 1

FNA5521/28


A
F
B
G
E
C
D
DIGIT 1
DIGIT 2
DIGIT 3
DIGIT 4
DIGIT 5
PIN 1

FND350 • FND360 • FND357 • FND367

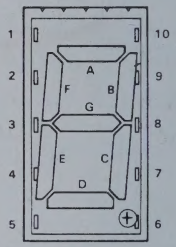
RED GaAsP 0.362—INCH SINGLE DIGIT NUMERIC LED DISPLAY

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION—The FND350, FND360, FND357 and FND367 are red GaAsP single digit 7-segment displays with a 3/8 inch character height. FND357 and FND367 are common cathode configuration. These displays are designed for applications in which the viewer is within fifteen feet of the display. Each digit has a brightness code (05, 06, 07 . . .) for brightness consistency within a display. The FND360 and FND367 are suitable for applications in high-ambient light.

- **COMPACT—10 DIGITS IN 3" PANEL WIDTH**
- **LOW CURRENT REQUIREMENTS 2-20 mA/SEGMENT**
- **LOW VOLTAGE 1.7 V**
- **INTENSITY CODE MARKING FOR UNIFORM DISPLAYS**
- **RIGHT-HAND DECIMAL**
- **MAXIMIZED CONTRAST RATIO WITH INTEGRAL LENS CAP**
- **FND360, FND367 SUITABLE FOR USE IN HIGH AMBIENT LIGHT**

PIN CONNECTIONS
(FRONT VIEW)



PIN	FND357/367	FND350/360
1	Common Cath.	Common Anode
2	Segment F	Segment F
3	Segment G	Segment G
4	Segment E	Segment E
5	Segment D	Segment D
6	Common Cath.	Common Anode
7	Decimal Point	Decimal Point
8	Segment C	Segment C
9	Segment B	Segment B
10	Segment A	Segment A

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Junction Temperature	-25°C to +85°C
Storage Temperature	-25°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	98%

Maximum Voltage and Currents

V_R	Reverse Voltage	3.0 V
$I_{F(Avg)}$	Average Forward Current/Segment or Decimal Point	25 mA
	Derate from 25°C Ambient Temperature	0.3 mA/°C
I_{pk}	Peak Current/Segment or Decimal Point (100 μs pulse) 1000 pps, $T_A = 25°C$	200 mA

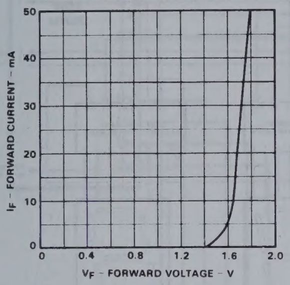
ELECTRICAL CHARACTERISTICS: $T_A = 25°C$

SYMBOL	CHARACTERISTICS	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.7	2.0	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	3.0	12		V	$I_R = 1.0$ mA
I_O	Axial Luminous Intensity					
	Each Segment (Note 1)					
	FND350, 357	240	450		μcd	$I_F = 20$ mA
	FND360, 367	590	900			
ΔI_O	Intensity Matching, Segment to Segment (Note 3)		±33		%	$I_F = 20$ mA
	Intensity Matching Within One Intensity Class		±20		%	$I_F = 20$ mA, all segments at once
L_O	Average Segment Luminance (Note 2)					
	FND350, 357		26		ftL	$I_F = 20$ mA
	FND360, 367		52			
$\theta_{1/2}$	Viewing Angle to Half Intensity		±27		degrees	
λ_{pk}	Peak Wavelength		665		nm	$I_F = 20$ mA

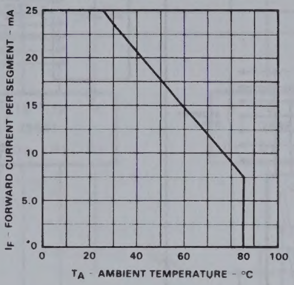
NOTES:
1. Typical operating current under single digit (dc) drive is approximately 2 to 20 mA average per segment for most ambient light conditions. The 125 mA specification is a representative peak current.
2. Measured on mechanical axis of package. See Average Luminous Intensity curve for other forward currents.
3. Segment-to-segment from average segment intensity.

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

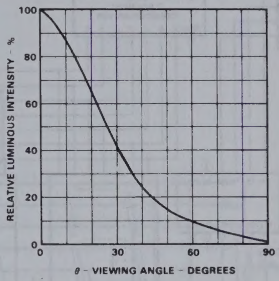
FORWARD CURRENT VERSUS FORWARD VOLTAGE



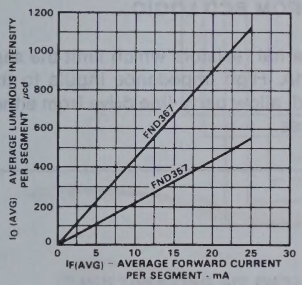
MAXIMUM AVERAGE CURRENT RATING VERSUS AMBIENT TEMPERATURE



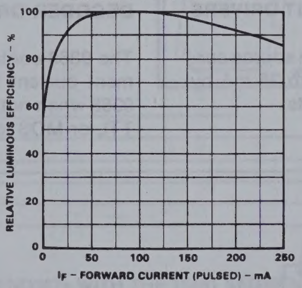
ANGULAR DISTRIBUTION OF LUMINOUS INTENSITY



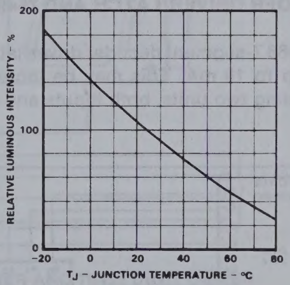
AVERAGE LUMINOUS INTENSITY VERSUS AVERAGE FORWARD CURRENT



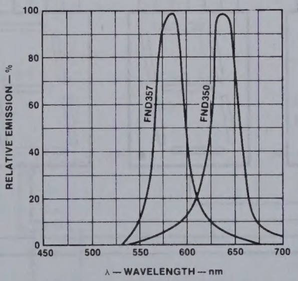
RELATIVE LUMINOUS EFFICIENCY (mcd PER mA) VERSUS PEAK CURRENT PER SEGMENT



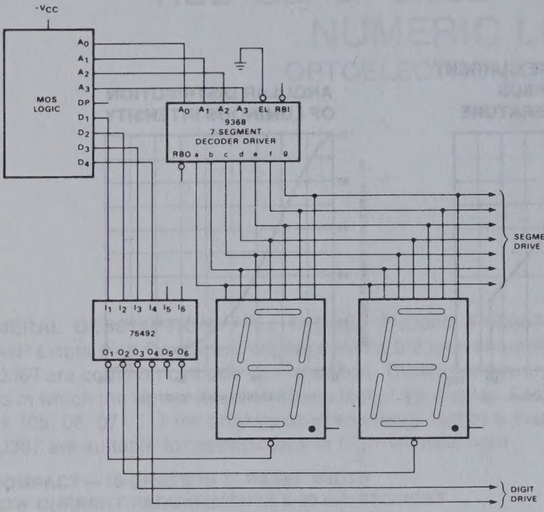
RELATIVE LUMINOUS INTENSITY VERSUS JUNCTION TEMPERATURE

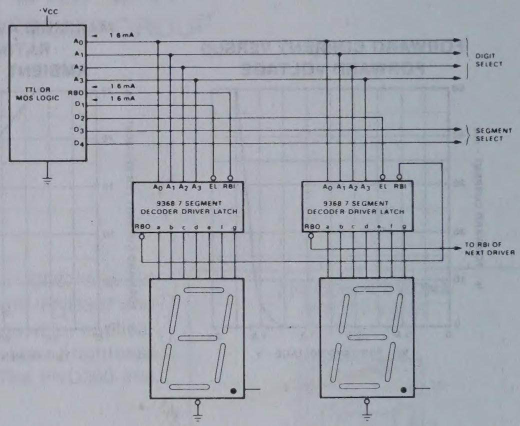


EMISSION SPECTRUM



APPLICATIONS


+VCC
MOS LOGIC
A0
A1
A2
A3
DP
D1
D2
D3
D4
A0 A1 A2 A3 EL RBI
9368 7 SEGMENT DECODER DRIVER
RBO a b c d e f g
SEGMENT DRIVE
I1 I2 I3 I4 I5 I6
75492
O1 O2 O3 O4 O5 O6
DIGIT DRIVE

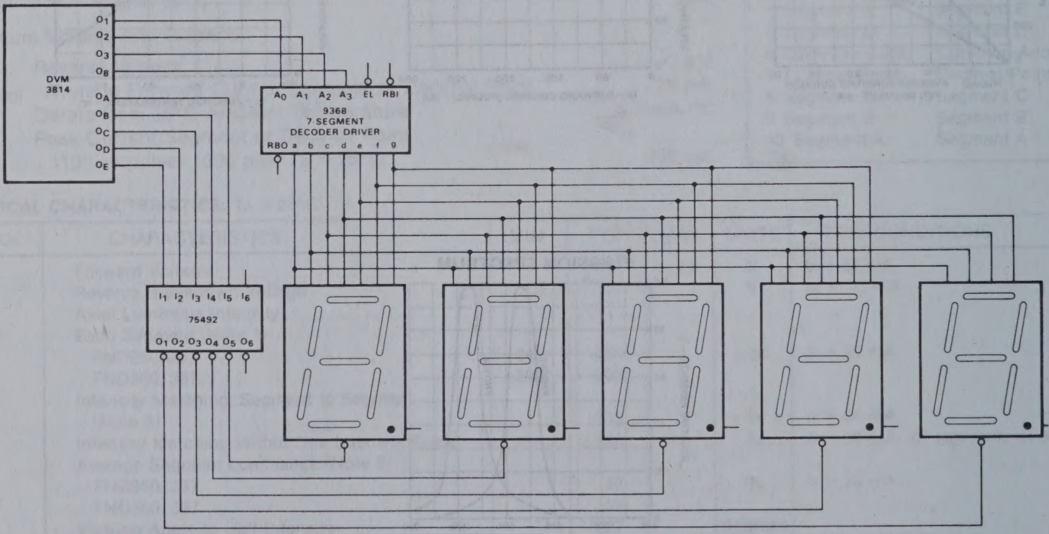

+VCC
TTL OR MOS LOGIC
A0
A1
A2
A3
RBO
D1
D2
D3
D4
1.6 mA
1.6 mA
1.6 mA
DIGIT SELECT
SEGMENT SELECT
A0 A1 A2 A3 EL RBI
9368 7 SEGMENT DECODER DRIVER LATCH
RBO a b c d e f g
A0 A1 A2 A3 EL RBI
9368 7 SEGMENT DECODER DRIVER LATCH
RBO a b c d e f g
TO RBI OF NEXT DRIVER

MULTIPLEXING FND357 WITH 9368 7-SEGMENT DECODER DRIVER/LATCH AND 75492 DIGIT DRIVERS

The 9368 7-segment decoder driver/latch can source current up to 19 mA. This may be increased to 38 mA by paralleling two units, both inputs and outputs.

DRIVING THE FND357 WTIH THE 9368 LATCH/ DECODER/DRIVER FROM BCD LOGIC

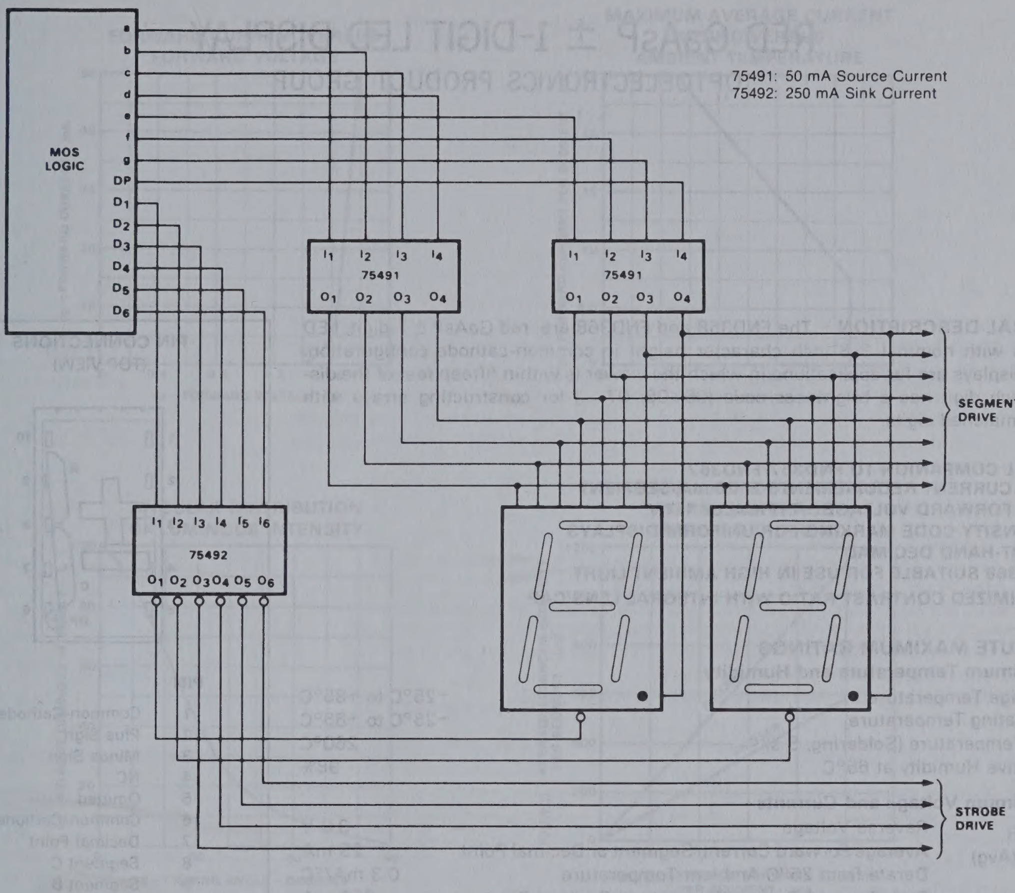
The 9368 contains internal resistors which limit the segment current to 19 mA. High impedance inputs to the 9368 when not enabled, allow party-line drive from either TTL or MOS logic gates.


DVM 3814
O1
O2
O3
O8
OA
OB
OC
OD
OE
A0 A1 A2 A3 EL RBI
9368 7 SEGMENT DECODER DRIVER
RBO a b c d e f g
I1 I2 I3 I4 I5 I6
75492
O1 O2 O3 O4 O5 O6

LOW COST DIGITAL VOLTMETER

9368 7-Segment Decoder Driver/Latch: Source Current = 19 mA
75492 Hex Digit Driver: Sink Current = 250 mA

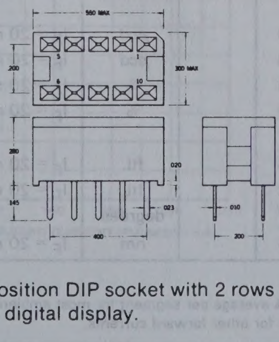
APPLICATIONS (Cont'd)


a
b
c
d
e
f
g
DP
D1
D2
D3
D4
D5
D6
MOS LOGIC
I1 I2 I3 I4
75491
O1 O2 O3 O4
I1 I2 I3 I4
75491
O1 O2 O3 O4
I1 I2 I3 I4 I5 I6
75492
O1 O2 O3 O4 O5 O6
SEGMENT DRIVE
STROBE DRIVE

75491: 50 mA Source Current
75492: 250 mA Sink Current

MULTIPLEXING SIX FND357s OR FND367s WITH THE 75491 SEGMENT DRIVER AND 75492 DIGIT DRIVER

FNS700
10-POSITION DIP SOCKET FOR FND357 OR FND367


550 MAX
1
5
6
10
200
300 MAX
280
020
145
023
010
400
200

NOTES:
Material
  Insulator:
    Black Nylon, Glass Filled
    Wellamid or Equivalent
  Contact
    Phosphorous Bronze
    Nickel Plate
    Gold Plate

The FNS700 is a 10-position DIP socket with 2 rows of 5 positions each which is designed for use with the FND357 and the FND367 3/8" LED digital display.

FND358 • FND368

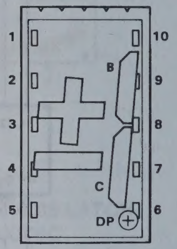
RED GaAsP ± 1-DIGIT LED DISPLAY

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The FND358 and FND368 are red GaAsP ± 1-digit, LED displays with nominal 3·8 inch character height in common-cathode configuration. These displays are for applications in which the viewer is within fifteen feet of the display. Each digit has a brightness code (05, 06, 07 ...) for constructing arrays with closely matched digits.

- **IDEAL COMPANION TO FND357/FND367**
- **LOW CURRENT REQUIREMENTS 2–20 mA/SEGMENT**
- **LOW FORWARD VOLTAGE – TYPICALLY 1.7 V**
- **INTENSITY CODE MARKING FOR UNIFORM DISPLAYS**
- **RIGHT-HAND DECIMAL**
- **FND368 SUITABLE FOR USE IN HIGH AMBIENT LIGHT**
- **MAXIMIZED CONTRAST RATIO WITH INTEGRAL LENS CAP**

PIN CONNECTIONS
(TOP VIEW)



PIN	
1	Common-Cathode
2	Plus Sign
3	Minus Sign
4	NC
5	Omitted
6	Common-Cathode
7	Decimal Point
8	Segment C
9	Segment B
10	NC

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	−25°C to +85°C
Operating Temperature	−25°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	98%

Maximum Voltage and Currents

V_R	Reverse Voltage	3.0 V
$I_{F(Avg)}$	Average Forward Current/Segment or Decimal Point	25 mA
	Derate from 25°C Ambient Temperature	0.3 mA/°C
i_f	Peak Forward Current/Segment or Decimal Point (100 μs pulse width) 1000 pps, $T_A = 25°C$	200 mA

ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

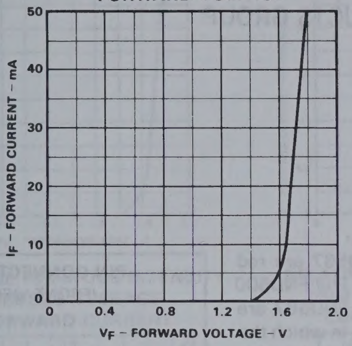
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage	1.5	1.7	2.0	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	3.0	12		V	$I_R = 1.0$ mA
I_O	Axial Luminous Intensity, Average for Each Segment (Note 1)					
	FND358	240	450		μcd	$I_F = 20$ mA
	FND368	590	900		μcd	$I_F = 20$ mA
ΔI_O	Intensity Matching, Segment-to-Segment (Note 3)		±33		%	$I_F = 20$ mA
	Intensity Matching Within One Intensity Class		±20		%	$I_F = 20$ mA, all segments at once
L_O	Average Segment Luminance (Note 2)					
	FND357		26		ftL	$I_F = 20$ mA
	FND367		52		ftL	$I_F = 20$ mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		±27		degrees	
λ_{pk}	Peak Wavelength		665		nm	$I_F = 20$ mA

NOTES:

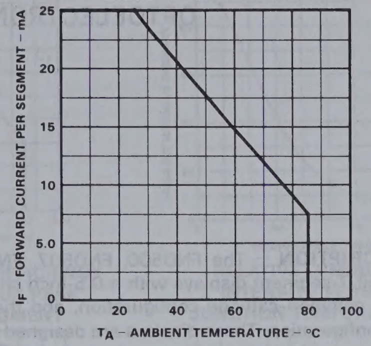
1. Typical operating current under single digit (dc) drive is approximately 2 to 20 mA average per segment for most ambient light conditions.
2. Measured on mechanical axis of package. See Average Luminous Intensity curve for other forward currents.
3. Segment-to-segment from average segment intensity.

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

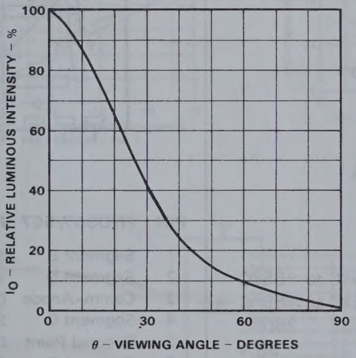
FORWARD CURRENT VERSUS FORWARD VOLTAGE



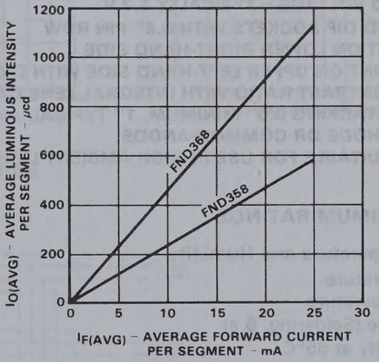
MAXIMUM AVERAGE CURRENT RATING VERSUS AMBIENT TEMPERATURE



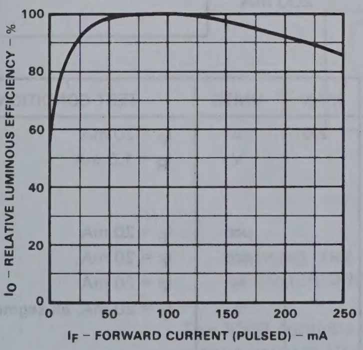
ANGULAR DISTRIBUTION OF LUMINOUS INTENSITY



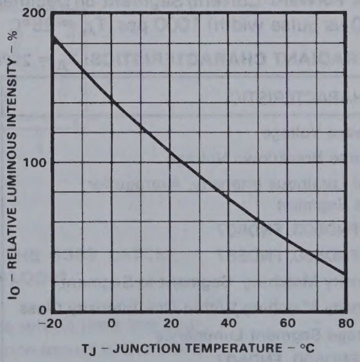
AVERAGE LUMINOUS INTENSITY VERSUS AVERAGE FORWARD CURRENT



RELATIVE LUMINOUS EFFICIENCY (mcd PER mA) VERSUS PEAK CURRENT PER SEGMENT



RELATIVE LUMINOUS INTENSITY VERSUS JUNCTION TEMPERATURE



FND500 • FND507 • FND560 • FND567

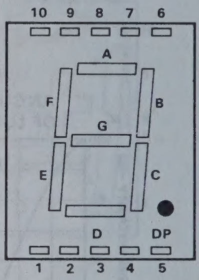
RED GaAsP 0.5-INCH SINGLE DIGIT NUMERIC LED DISPLAY

OPTOELECTRONICS PRODUCTS GROUP

GENERAL DESCRIPTION – The FND500, FND507, FND560 and FND567 are red GaAsP Single Digit 7-segment displays with a 0.5-inch character height. The FND500 and FND560 are common-cathode configuration, and the FND507 and FND567 are common-anode configuration. These displays are designed for applications in which the viewer is within twenty feet of the display. Each digit has a brightness code (05, 06, 07 . . .) for brightness consistency within a display. The FND560 and FND567 are suitable for applications in high ambient light.

- **LOW FORWARD VOLTAGE – TYPICALLY 1.7 V**
- **FITS STANDARD DIP SOCKETS WITH 0.6" PIN ROW**
- **DECIMAL POINT ON LOWER RIGHT-HAND SIDE**
- **OVERFLOW POINT ON UPPER LEFT-HAND SIDE WITH DIGIT REVERSED**
- **MAXIMIZED CONTRAST RATIO WITH INTEGRAL LENS CAP**
- **HORIZONTAL STACKING 0.6" MINIMUM, 1" TYPICAL**
- **COMMON-CATHODE OR COMMON-ANODE**
- **FND560/567 SUITABLE FOR USE IN HIGH AMBIENT LIGHT**

PIN CONNECTIONS
(FRONT VIEW)



PIN	FND507/567	FND500/560
1	Segment E	Segment E
2	Segment D	Segment D
3	Comm.-Anode	Comm.-Cathode
4	Segment C	Segment C
5	Decimal Point	Decimal Point
6	Segment B	Segment B
7	Segment A	Segment A
8	Comm.-Anode	Comm.-Cathode
9	Segment F	Segment F
10	Segment G	Segment G

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	−25°C to +85°C
Operating Temperature	−25°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	98%

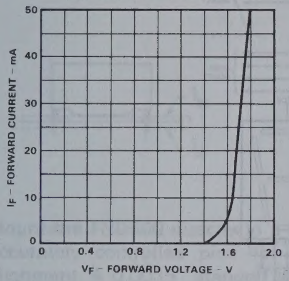
Maximum Voltage and Currents

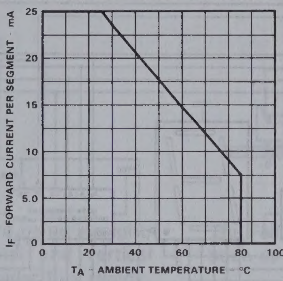
V_R	Reverse Voltage	3.0 V
$I_{F(Avg)}$	Average Forward Current/Segment or Decimal Point Derate from 25°C Ambient Temperature	25 mA 0.3 mA/°C
i_f	Peak Forward Current/Segment or Decimal Point (100 μs pulse width) 1000 pps, T_A = 25°C	200 mA

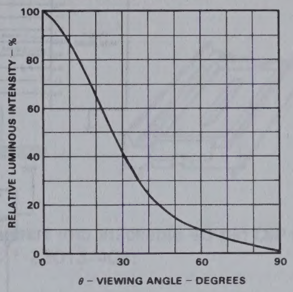
ELECTRICAL AND RADIANT CHARACTERISTICS: T_A = 25°C

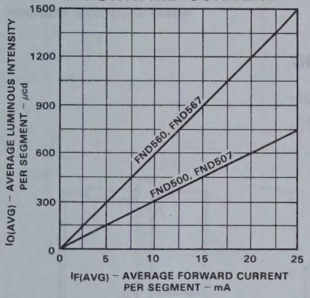
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage	1.5	1.7	2.0	V	I_F = 20 mA
BV_R	Reverse Breakdown Voltage	3.0	12		V	I_R = 1.0 mA
I_O	Axial Luminous Intensity, Average for Each Segment					
	FND500, FND507	300	600		μcd	I_F = 20 mA
	FND560, FND567	740	1200		μcd	I_F = 20 mA
ΔI_O	Intensity Matching, Segment to Segment		±33		%	I_F = 20 mA
	Intensity Matching Within One Intensity Class		±20		%	I_F = 20 mA, all segments at once
L_O	Average Segment Luminance					
	FND500, FND507		35		ftL	I_F = 20 mA
	FND560, FND567		70		ftL	I_F = 20 mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		±27		degrees	
λ_{pk}	Peak Wavelength		665		nm	I_F = 20 mA

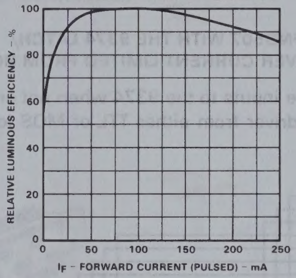
TYPICAL CHARACTERISTIC CURVES

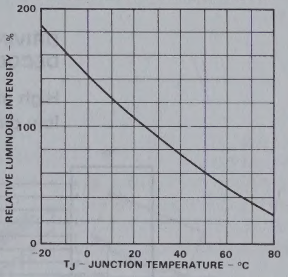

FORWARD CURRENT VERSUS FORWARD VOLTAGE


MAXIMUM AVERAGE CURRENT RATING VERSUS AMBIENT TEMPERATURE

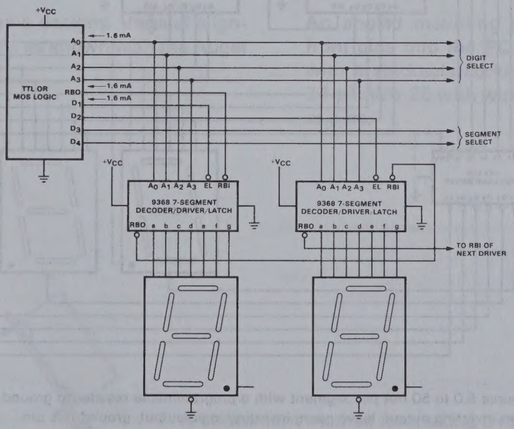

ANGULAR DISTRIBUTION OF LUMINOUS INTENSITY


AVERAGE LUMINOUS INTENSITY VERSUS AVERAGE FORWARD CURRENT


RELATIVE LUMINOUS EFFICIENCY (mcd PER mA) VERSUS PEAK CURRENT PER SEGMENT


RELATIVE LUMINOUS INTENSITY VERSUS JUNCTION TEMPERATURE

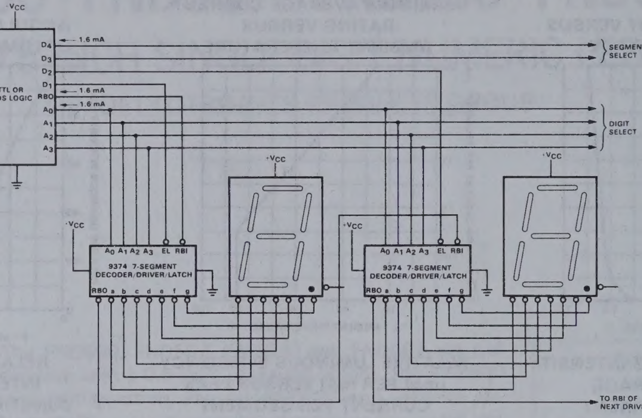
APPLICATIONS


+V_{CC}
TTL OR MOS LOGIC
A_0
A_1
A_2
A_3
RBO
D_1
D_2
D_3
D_4
1.6 mA
1.6 mA
1.6 mA
DIGIT SELECT
SEGMENT SELECT
+V_{CC}
A_0 A_1 A_2 A_3 EL RBI
9368 7-SEGMENT DECODER/DRIVER/LATCH
RBO a b c d e f g
+V_{CC}
A_0 A_1 A_2 A_3 EL RBI
9368 7-SEGMENT DECODER/DRIVER/LATCH
RBO a b c d e f g
TO RBI OF NEXT DRIVER

DRIVING THE FND500 WITH THE 9368 LATCH/DECODER/DRIVER FROM BCD LOGIC

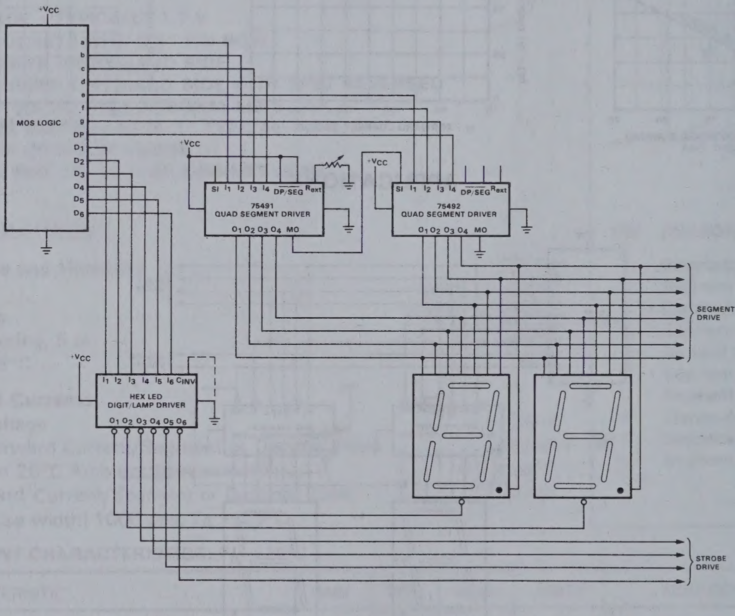
The 9368 contains internal resistors which limit the segment current to 19 mA. High impedance inputs to the 9368 when not enabled, allow party-line drive from either TTL or MOS logic gates.

APPLICATIONS (Cont'd)


+Vcc
TTL OR MOS LOGIC
D4
D3
D2
D1
RBO
A0
A1
A2
A3
1.6 mA
1.6 mA
1.6 mA
SEGMENT SELECT
DIGIT SELECT
+Vcc
A0 A1 A2 A3 EL RBI
9374 7-SEGMENT DECODER/DRIVER/LATCH
RBO a b c d e f g
TO RBI OF NEXT DRIVER

DRIVING THE FND507 WITH THE 9374 LATCH/DECODER/DRIVER CURRENT LIMITED FROM BCD LOGIC

High impedance inputs to the 9374 when not enabled, allow party-line driver from either TTL or MOS logic gates.

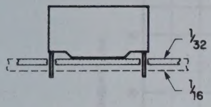

+Vcc
MOS LOGIC
a
b
c
d
e
f
g
DP
D1
D2
D3
D4
D5
D6
SI I1 I2 I3 I4 DP/SEG Rext
75491 QUAD SEGMENT DRIVER
O1 O2 O3 O4 MO
75492 QUAD SEGMENT DRIVER
I1 I2 I3 I4 I5 I6 CINV
HEX LED DIGIT/LAMP DRIVER
O1 O2 O3 O4 O5 O6
SEGMENT DRIVE
STROBE DRIVE

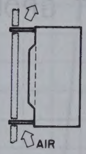
*Source 5.0 to 50 mA per segment with a programmable resistor to ground.
**Non-inverting output, leave open; inverting logic output; ground this pin.

MULTIPLEXING SIX FND500s WITH THE 75491 SEGMENT DRIVER AND 75492 DIGIT DRIVER

The 75491 segment driver has four inputs which are MOS compatible and four outputs. Output current is programmable from 5.0 to 50 mA with one external resistor. A master/slave pin, allows a second 75491 to be tied to the first 75491 and have the same segment drive current. A decimal-point pin reduces the output current in channel four by half. The 75492 digit driver has six channels, is MOS compatible, will sink 600 mA per channel, and has a pin for inverting the drive logic.

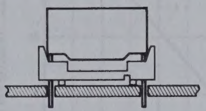
MOUNTING INSTRUCTIONS

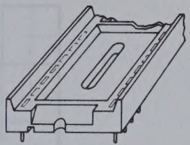




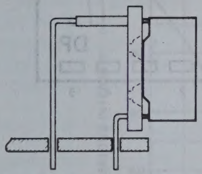
Mount the FND500 directly to a PC board using straight, accurately controlled pins for horizontal and vertical alignment. A 0.0035" standoff allows solder flux removal*. Long pins allow additional cooling behind the digit when mounted vertically.

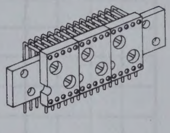
*Only certain cleaning solutions are allowed: Freon TF, methyl alcohol, isopropyl alcohol, or water.



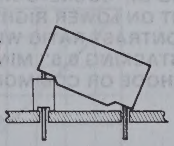


The FND500 will insert into stackable 40-pin DIP sockets, such as Barnes 821-23013-404.

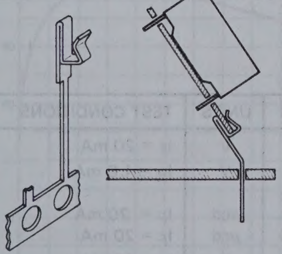




Right angle sockets simplify some designs. Vertical alignment of the sockets is necessary, as shown with the Augat socket GX51-73-1G1.



An angled mounting may be obtained by soldering the front pins into the PC board, then raising the back pins with a stackable socket strip such as Robinson Nugent's 24-pin WB-25 with wire-wrap pins, or SB-25 with DIP solder pins.



A convenient method for making a removable display is to first solder all the digits to a 1/32 PC board with appropriate interconnections for multiplexing, then attach the display to the mother board with a substrate clip, such as AMP485092-4.

FND501 • FND508 • FND561 • FND568

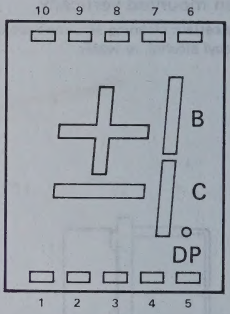
RED GaAsP 0.5 INCH ±1 LED DISPLAY

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION — The FND501, FND 561, FND508 and FND568 are Red GaAsP overflow LED displays with a nominal 0.5 inch character height. The FND 501 has common-cathode configuration. The FND508 has common-anode configuration. These display devices are for applications where the viewer is within twenty feet of the display. Each digit has a brightness code (05, 06, 07 ...) for constructing arrays with closely matched digits. The FND561 and FND568 are suitable for applications in high ambient light.

- LOW VOLTAGE OF TYPICALLY 1.7 V_F
- FITS STANDARD DIP SOCKETS WITH 0.6'' PIN ROW
- DECIMAL POINT ON LOWER RIGHT-HAND SIDE
- MAXIMIZED CONTRAST RATIO WITH INTEGRAL LENS CAP
- HORIZONTAL STACKING 0.6'' MINIMUM, 1'' TYPICAL
- COMMON-CATHODE OR COMMON-ANODE

PIN CONNECTIONS
(TOP VIEW)



PIN	FND501/561	FND508/568
1	Minus	Minus
2	Cathode ±	Anode ±
3	Segment C	Segment C
4	Cathode 1/D.P.	Anode 1/D.P.
5	D.P.	D.P.
6	Segment B	Segment B
7	Cathode 1/D.P.	Anode 1/D.P.
8	Cathode ±	Anode ±
9	Plus	Plus
10	N.C.	N.C.

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	−25°C to +85°C
Operating Temperature	−25°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	98%

Maximum Voltage and Currents

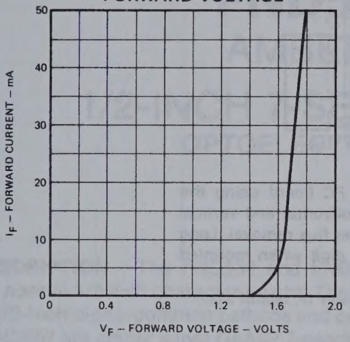
V_R	Reverse Voltage	3.0 V
$I_{F(Avg)}$	Average Forward Current/Segment or Decimal Point	25 mA
	Derate from 25°C Ambient Temperature	0.3 mA/°C
i_f	**Peak Forward Current/Segment or Decimal Point** (100 μs pulse width) 1000 pps, $T_A = 25°C$	200 mA

ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

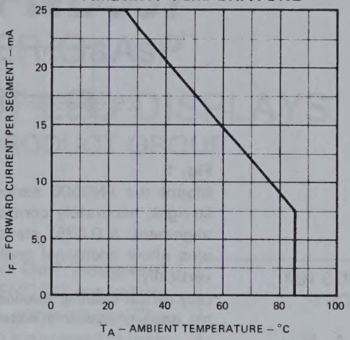
SYMBOL	CHARCTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.7	2.0	V	$I_F = 20$ mA
BV_R	Resverse Breakdown Voltage	3.0	12		V	$I_R = 1.0$ mA
I_O	Axial Luminous Intensity, Each Segment					
	FND501, FND508	300	600		μcd	$I_F = 20$ mA
	FND561, FND568	740	1200		μcd	$I_F = 20$ mA
ΔI_O	Intensity Matching, Segment to Segment		±33		%	$I_F = 20$ mA
	Intensity Matching Within One Intensity Class		±20		%	$I_F = 20$ mA, all segments at once
L_O	Average Segment Luminance					
	FND501, FND508		35		ftL	$I_F = 20$ mA
	FND561, FND568		70		ftL	$I_F = 20$ mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		±27		degrees	
λ	Peak Wavelength		665		nm	$I_F = 20$ mA

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

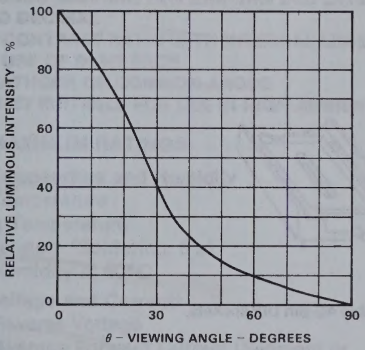
FORWARD CURRENT VERSUS FORWARD VOLTAGE



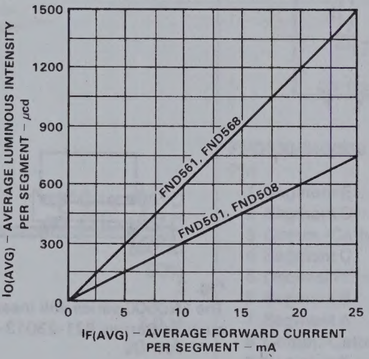
MAXIMUM AVERAGE CURRENT RATING VERSUS AMBIENT TEMPERATURE



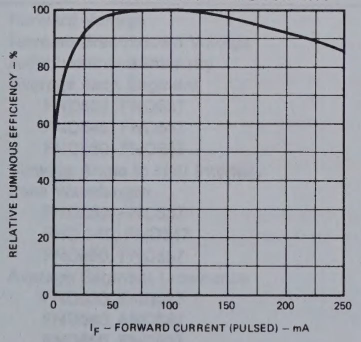
ANGULAR DISTRIBUTION OF LUMINOUS INTENSITY



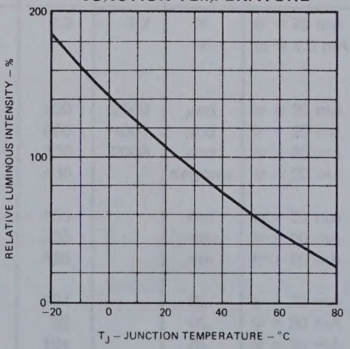
AVERAGE LUMINOUS INTENSITY VERSUS AVERAGE FORWARD CURRENT



RELATIVE LUMINOUS EFFICIENCY (mcd PER mA) VERSUS PEAK CURRENT PER SEGMENT



RELATIVE LUMINOUS INTENSITY VERSUS JUNCTION TEMPERATURE



MOUNTING INSTRUCTIONS

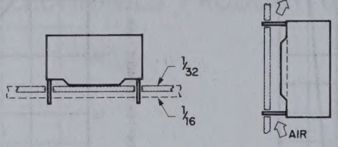


Fig. 1
Mount the FND500 series directly to a PC board using the straight, accurately controlled pins for horizontal and vertical alignment. A 0.035" standoff allows solder flux removal. Long pins allow additional cooling behind the digit when mounted vertically.*

*Only certain cleaning solutions are allowed: Freon TF, methyl alcohol, isopropyl alcohol, or water.

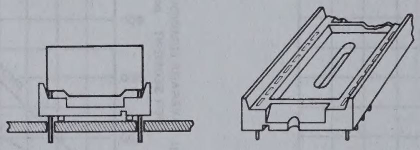


Fig. 2
The FND500 series will insert into stackable 40-pin DIP sockets, such as Barnes 821-23013-404.

FND530 • FND537 FND540 • FND547

GREEN GaP YELLOW SUPER GaAsP

FND550 • FND557

AMBER SUPER GaAsP

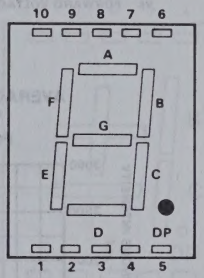
1/2-INCH 7-SEGMENT LED DISPLAYS

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION — The FND530 and FND537 are green GaP 7-segment displays with a normal 1/2 inch character height. The FND540 and FND547 are yellow Super GaAsP 1/2-inch digits, common cathode and common anode, respectively. The FND550 and FND557 are amber super GaAsP 7-segment digits with a normal 1/2 inch character height. The FND550 is common-cathode configuration while the FND557 is common-anode. These display devices are for applications where the viewer is within 20 feet of the display. Each digit has a brightness code (09, 10, 11 . . .) for constructing arrays with closely matched digits.

- **FITS STANDARD SOCKETS WITH 0.6 INCH PIN ROW**
- **INTENSITY CODE MARKING FOR UNIFORM DISPLAYS**
- **RIGHT-HAND DECIMAL**
- **MAXIMIZED CONTRAST RATIO WITH INTEGRAL LENS CAP**
- **MAXIMIZED USE OF DIGIT FACE**
- **COMMON-CATHODE OR COMMON-ANODE**
- **FND550/FND557 SUITABLE FOR USE IN HIGH AMBIENT LIGHT**

PIN CONNECTIONS
(FRONT VIEW)



Pin	FND530/540/550	FND537/547/557
1	Segment E	Segment E
2	Segment D	Segment D
3	Comm.-Cathode	Comm.-Anode
4	Segment C	Segment C
5	Decimal Point	Decimal Point
6	Segment B	Segment B
7	Segment A	Segment A
8	Comm.-Cathode	Comm.-Anode
9	Segment F	Segment F
10	Segment G	Segment G

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	-25°C to +85°C
Operating Temperature	-25°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 60°C	90%

Maximum Voltage and Currents

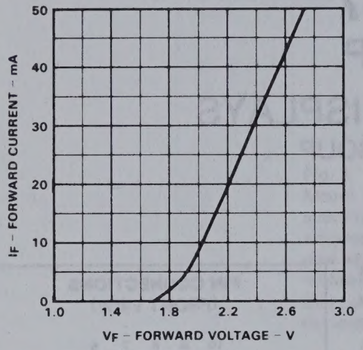
V_R	Reverse Voltage	3.0 V
$I_{F(Avg)}$	Average Forward Current (Segment or Decimal Points	20 mA
I_{PK}	Peak Forward Current (Segments or Decimals)	80 mA

ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

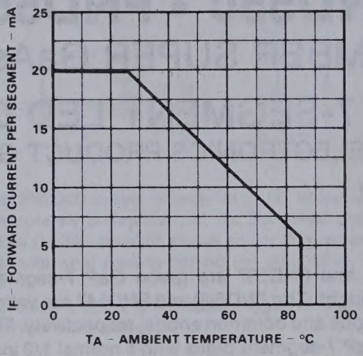
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		2.2	3.2	V	$I_F = 20$ mA
BV_R	Reverse Breadkdown Voltage	3.0			V	$I_R = 1.0$ mA
I_o	Axial Luminous Intensity					
	Average each Segment					
	FND530, FND537		600	2000	µcd	$I_F = 20$ mA
	FND540, FND547		600	1000	µcd	$I_F = 20$ mA
	FND550, FND557		700	2000	µcd	$I_F = 20$ mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		±30		degrees	$I_F = 20$ mA
λ_{pk}	Peak Wavelength					
	FND530, FND537		565		nm	$I_F = 20$ mA
	FND 540, FND547		585		nm	$I_F = 20$ mA
	FND550, FND557		635		nm	$I_F = 20$ mA
I_o	Average Segment Luminance					
	FND530, FND537		104		ftL	$I_F = 20$ mA
	FND540, FND547		52		ftL	$I_F = 20$ mA
	FND550, FND557		104		ftL	$I_F = 20$ mA
ΔI_o	Intensity Matching Segment-to-Segment		±33		%	$I_F = 20$ mA
	Intensity Matching within one Intensity Class		±20		%	$I_F = 20$ mA

TYPICAL CHARACTERISTIC CURVES

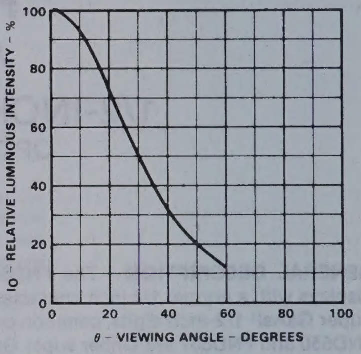
FORWARD CURRENT VERSUS FORWARD VOLTAGE



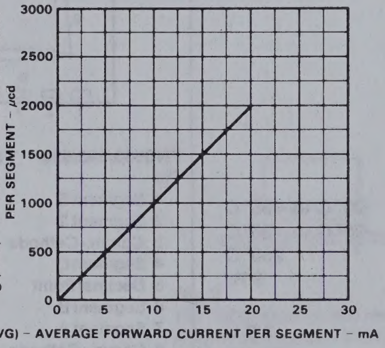
MAXIMUM AVERAGE CURRENT RATING VERSUS AMBIENT TEMPERATURE



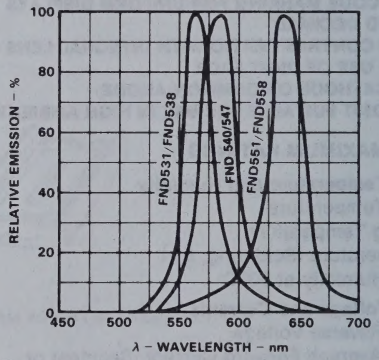
ANGULAR DISTRIBUTION OF LUMINOUS INTENSITY



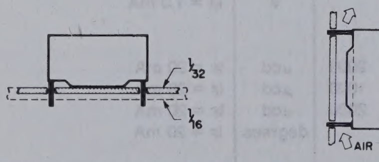
AVERAGE LUMINOUS INTENSITY VERSUS AVERAGE FORWARD CURRENT



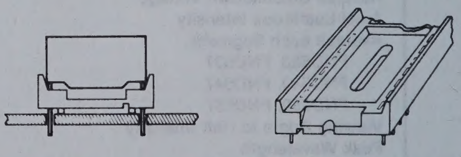
EMISSION SPECTRUM



MOUNTING INSTRUCTIONS



Mount the FNS500 series directly to a PC board using the straight, accurately controlled pins for horizontal and vertical alignment. A 0.0035" standoff allows solder flux removal. *Long pins allow additional cooling behind the digit when mounted vertically.



The FND500 series will insert into stackable 40-pin DIP sockets, such as Barnes 821-23013-404.

*Only certain cleaning solutions are allowed: Freon TF, methyl alcohol, isopropyl alcohol, or water.

FND531/538 • FND541/548 • FND551/558

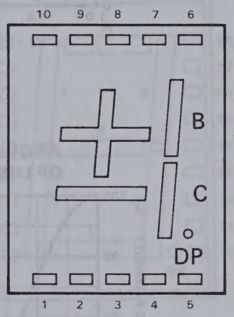
GREEN GaP YELLOW SUPER GaAsP AMBER SUPER GaAsP

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION — The FND531 and FND538 are green GaP ±Idisplays with a nominal 1/2 inch character height. The FND531 is common-cathode configuration, while the FND538 is common-anode. The FND541 and FND548 are yellow super GaAsP ±Idigits with a nominal 1/2 inch character height. The FND541 is common-cathode configuration while the FND548 is common-anode. The FND551 and FND558 are amber super GaAsP ±Idigits with a nominal 1/2 inch character height. The FND551 is common-cathode configuration while the FND558 is common-anode. These display devices are for applications where the viewer is within 20 feet of the display. Each digit has a brightness code (09, 10, 11. . .) for constructing arrays with closely matched digits.

- **FITS STANDARD SOCKETS WITH 0.6 INCH PIN ROW**
- **INTENSITY CODE MARKING FOR UNIFORM DISPLAYS**
- **RIGHT-HAND DECIMAL**
- **MAXIMIZED CONTRAST RATIO WITH INTEGRAL LENS CAP**
- **MAXIMIZED USE OF DIGIT FACE**
- **COMMON-CATHODE OR COMMON-ANODE**

CONNECTION DIAGRAM
(TOP VIEW)



PIN	FND531 FND541 FND551	FND538 FND548 FND558
1	Minus	Minus
2	Cathode ±	Anode ±
3	Segment C	Segment C
4	Cathode 1/D.P.	Anode 1/D.P.
5	D.P.	D.P.
6	Segment B	Segment B
7	Cathode 1/D.P.	Anode 1/D.P.
8	Cathode ±	Anode ±
9	Plus	Plus
10	N.C.	N.C.

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	-25° C to +85° C
Operating Temperature	-25° C to +85° C
Pin Temperature (Soldering, 5 s)	260° C
Relative Humidity at 60° C	90%

Maximum Voltage and Currents

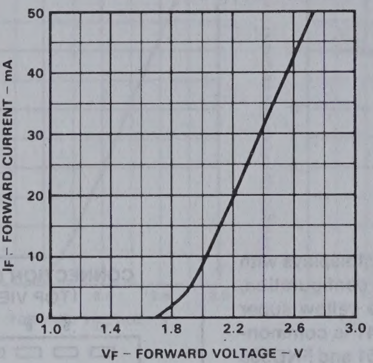
V_R	Reverse Voltage	3.0 V
I_F (Avg)	Average Forward Current (Segment or Decimal Points)	20 mA
I_F	Peak Forward Current (Segments or Decimals)	80 mA

ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

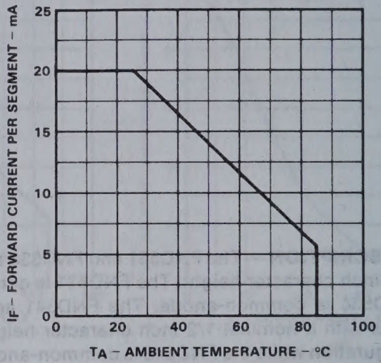
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		2.2	3.2	V	$I_F = 20$ mA
BV_R	Reverse Voltage Breakdown	3.0			V	$I_R = 1.0$ mA
I_O	Axial Luminous Intensity					
	Average each Segment					
	FND531, FND538	600	2000		μcd	$I_F = 20$ mA
	FND541, FND548	700	2000		μcd	$I_F = 20$ mA
	FND551, FND558	700	2000		μcd	$I_F = 20$ mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		±30		degrees	
λ_{pk}	Peak Wavelength					
	FND531, FND538		565		nm	$I_F = 20$ mA
	FND541, FND548		570		nm	$I_F = 20$ mA
	FND551, FND558		635		nm	$I_F = 20$ mA
L_O	Average Segment Luminance		104		ftL	$I_F = 20$ mA
ΔI_O	Intensity Matching Segment-to-Segment		±33		%	$I_F = 20$ mA
	Intensity Matching within one Intensity Class		±20		%	$I_F = 20$ mA

TYPICAL CHARACTERISTIC CURVES

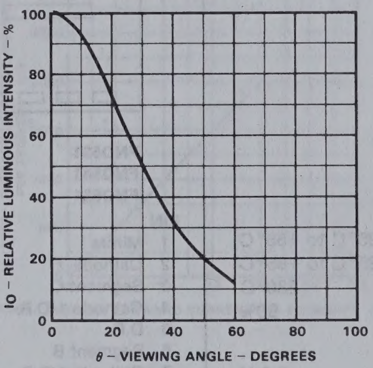
FORWARD CURRENT VERSUS FORWARD VOLTAGE



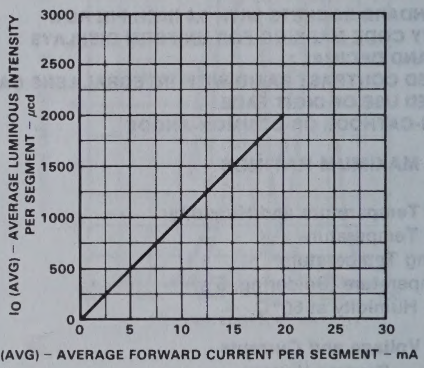
MAXIMUM AVERAGE CURRENT RATING VERSUS AMBIENT TEMPERATURE



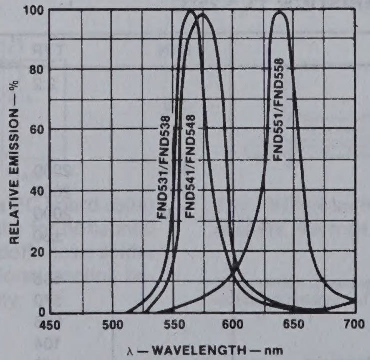
ANGULAR DISTRIBUTION OF LUMINOUS INTENSITY



AVERAGE LUMINOUS INTENSITY VERSUS AVERAGE FORWARD CURRENT



EMISSION SPECTRUM



FND800•FND807

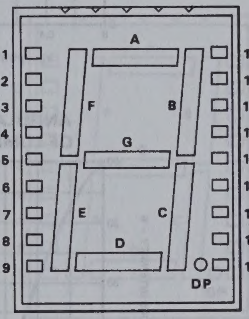
RED GaAsP 0.8 INCH SINGLE DIGIT NUMERIC LED DISPLAY

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The FND800 and FND807 are Red GaAsP Single Digit, 7-Segment LED Displays with a nominal 0.8″ character height. The FND800 has common-cathode configuration. The FND807 has common-anode configuration. These display devices are for applications where the viewer is within thirty feet of the display. Each digit has a brightness code (06, 07, 08 ...) for constructing arrays with closely matched digits.

- LOW CURRENT REQUIREMENTS OF TYPICALLY 10 mA/SEGMENT
- LOW VOLTAGE OF TYPICALLY 1.7 V_F
- FITS STANDARD DIP SOCKETS WITH 0.6″ PIN ROW
- DECIMAL POINT ON LOWER RIGHT-HAND SIDE
- OVERFLOW POINT ON UPPER LEFT-HAND SIDE WITH DIGIT REVERSED
- MAXIMIZED CONTRAST RATIO WITH INTEGRAL LENS CAP
- HORIZONTAL STACKING 1″ TYPICAL
- COMMON-CATHODE OR COMMON-ANODE

PIN CONNECTIONS
(TOP VIEW)



PIN	FND800	FND807
1	Omitted	Omitted
2	Segment A	Segment A
3	Segment F	Segment F
4	Common-Cath.	Common-Anode
5	Segment E	Segment E
6	Common-Cath.	Common-Anode
7	N.C.	N.C.
8	Omitted	Omitted
9	Omitted	Omitted
10	Decimal Point	Decimal Point
11	Segment D	Segment D
12	Common-Cath.	Common-Anode
13	Segment C	Segment C
14	Segment G	Segment G
15	Segment B	Segment B
16	Omitted	Omitted
17	Common-Cath.	Common-Anode
18	Omitted	Omitted

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	−25°C to +85°C
Operating Temperature	−25°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	98%

Maximum Voltage and Currents

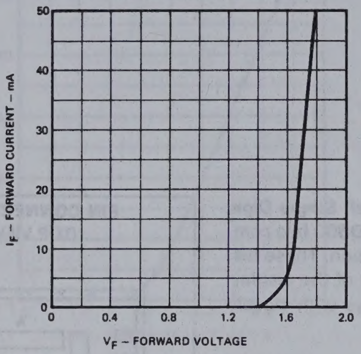
V_R	Reverse Voltage	3.0 V
$I_{F(Avg)}$	Average Forward Current, Segment or Decimal Point	25 mA
	Derate from 25°C Ambient Temperature	0.3 mA/°C
I_{pk}	Peak Current/Segment or Decimal Point (100 μs pulse width) 1000 pps, $T_A = 25°C$	200 mA

ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

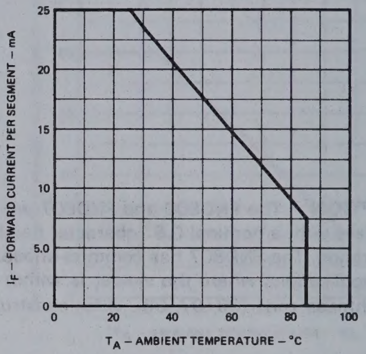
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage	1.5	1.7	2.0	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	3.0	12		V	$I_R = 1.0$ mA
I_O	Axial Luminous Intensity, Average for Each Segment	380	1100		μcd	$I_F = 20$ mA
ΔI_O	Intensity Matching, Segment-to-Segment		±33		%	$I_F = 20$ mA
	Intensity Matching Within One Intensity Class		±20		%	$I_F = 20$ mA, all segments at once
L_O	Average Segment Luminance		64		ftL	$I_F = 20$ mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		±25		degrees	
λ_{pk}	Peak Wavelength		665		nm	$I_F = 20$ mA

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

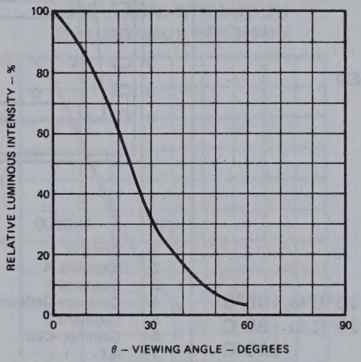
FORWARD CURRENT VERSUS FORWARD VOLTAGE



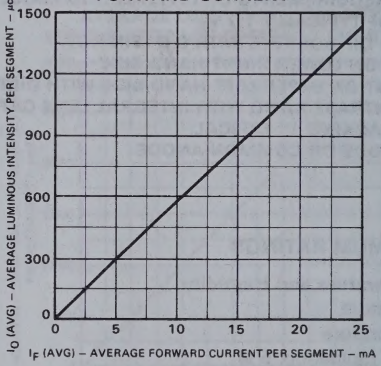
MAXIMUM AVERAGE CURRENT RATING VERSUS AMBIENT TEMPERATURE



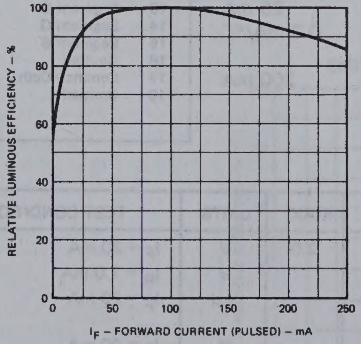
ANGULAR DISTRIBUTION OF LUMINOUS INTENSITY



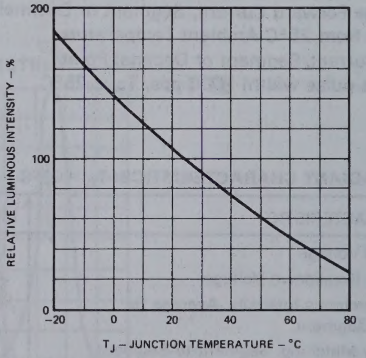
AVERAGE LUMINOUS INTENSITY VERSUS AVERAGE FORWARD CURRENT



RELATIVE LUMINOUS EFFICIENCY (mcd PER mA) VERSUS PEAK CURRENT PER SEGMENT



RELATIVE LUMINOUS INTENSITY VERSUS JUNCTION TEMPERATURE



FND800A • FND807A

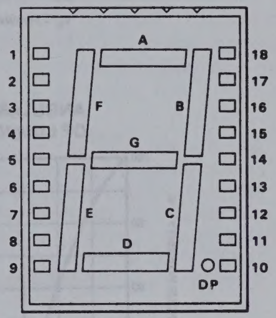
RED GaAsP 0.8 INCH SINGLE DIGIT NUMERIC LED DISPLAY

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION — The FND800A and FND807A are Red GaAsP Single Digit, 7-Segment LED Displays with a nominal 0.8" character height. The FND 800 has common cathode configuration. The FND807 has common anode configuration. These display devices are for applications where the viewer is within thirty feet of the display. Each digit has a brightness code (05, 06, 07 . . .) for constructing arrays with closely matched digits. This second-generation design maximizes viewing angle.

- **LOW CURRENT REQUIREMENTS OF TYPICALLY 20 mA/SEGMENT**
- **LOW VOLTAGE OF TYPICALLY 1.7 V_F**
- **FITS STANDARD DIP SOCKETS WITH 0.6" PIN ROW**
- **DECIMAL POINT ON LOWER RIGHT-HAND SIDE**
- **OVERFLOW POINT ON UPPER LEFT-HAND SIDE WITH DIGIT REVERSED**
- **MAXIMIZED CONTRAST RATIO WITH INTEGRAL LENS CAP**
- **HORIZONTAL STACKING 1" TYPICAL**
- **COMMON CATHODE OR COMMON ANODE**

PIN CONNECTIONS
(TOP VIEW)



PIN	FND800	FND807
1	Omitted	Omitted
2	Segment A	Segment A
3	Segment F	Segment F
4	Common Cath.	Common Anode
5	Segment E	Segment E
6	Common Cath.	Common Anode
7	N.C.	N.C.
8	Omitted	Omitted
9	Omitted	Omitted
10	Decimal Point	Decimal Point
11	Segment D	Segment D
12	Common Cath.	Common Anode
13	Segment C	Segment C
14	Segment G	Segment G
15	Segment B	Segment B
16	Omitted	Omitted
17	Common Cath.	Common Anode
18	Omitted	Omitted

ABSOLUTE MAXIMUM RATINGS

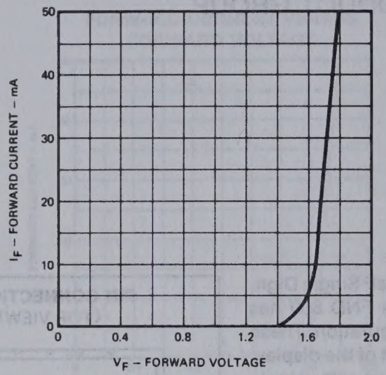
Maximum Temperature and Humidity		
	Junction Temperature	-25°C to +85°C
	Storage Temperature	-25°C to +85°C
	Pin Temperature (Soldering, 5 s)	260°C
	Relative Humidity @ 65°C	98%
Maximum Voltage and Currents		
V_R	Reverse Voltage	3.0 V
$I_{F(Avg)}$	Average Forward Current, Segment or Decimal Point	25 mA
	Derate from 25°C Ambient Temperature (Fig. 2)	0.3 mA/°C
I_{pk}	Peak Current, Segment or Decimal Point (100 μs pulse width) 1000 PPS, T_A = 25°C	200 mA

ELECTRICAL AND RADIANT CHARACTERISTICS: T_A = 25°C

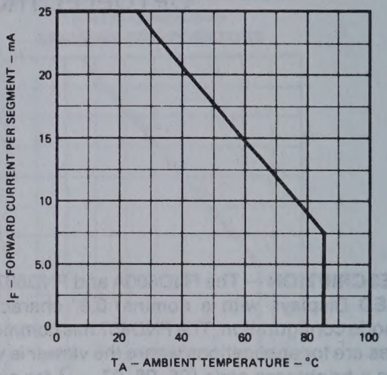
SYMBOL	CHARACTERISTICS	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.7	2.0	V	I_F = 20 mA
V_R	Reverse Voltage	3.0	12		V	I_R = 1.0 mA
I_O	Axial Luminous Intensity, Each Segment	240	600		μcd	I_F = 20 mA
ΔI_O	Intensity Matching, Segment to Segment		±33		%	I_F = 20 mA
	Intensity Matching, Within One Intensity Class		±15		%	I_F = 20 mA on all segments at once
L_O	Average Segment Luminance		35		ftL	I_F = 20 mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		30		degrees	
λ_{pk}	Peak Wavelength		665		nm	I_F = 20 mA

TYPICAL CHARACTERISTIC CURVES

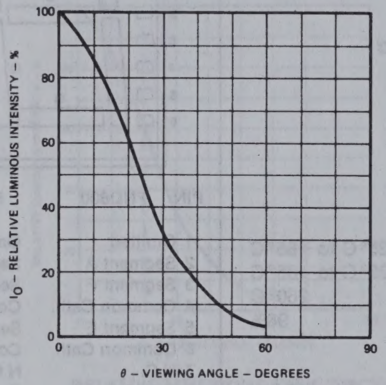
FORWARD CURRENT VERSUS FORWARD VOTLAGE



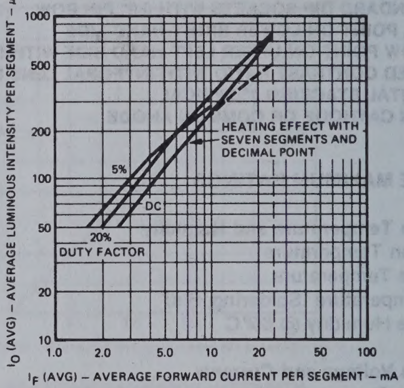
MAXIMUM AVERAGE CURRENT RATING VERSUS AMBIENT TEMPERATURE



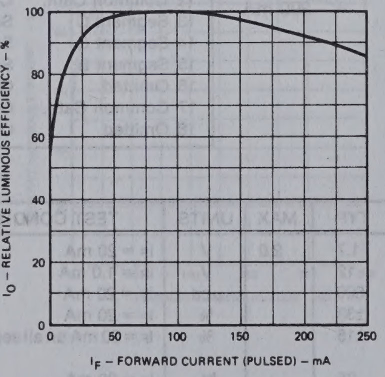
ANGULAR DISTRIBUTION OF LUMINOUS INTENSITY



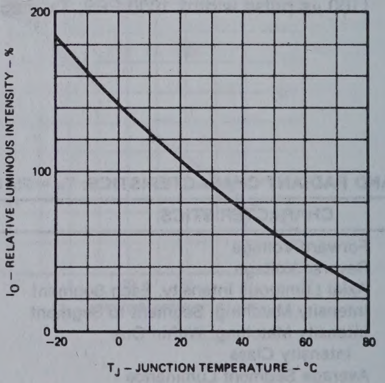
AVERAGE LUMINOUS INTENSITY VERSUS AVERAGE FORWARD CURRENT



RELATIVE LUMINOUS EFFICIENCY (mcd PER mA) VERSUS PEAK CURRENT PER SEGMENT



RELATIVE LUMINOUS INTENSITY VERSUS JUNCTION TEMPERATURE



FND801A • FND808A • FND846A • FND849A

RED GaAsP 0.8 INCH OVERFLOW LED DISPLAYS

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION — The FND801A and FND808A are overflow (±1) digits for use with the FND800A and FND807A, respectively. The FND846A and FND849A are overflow (±1) digits for use with the FND847A and FND850A respectively. These display devices are for applications where the viewer is within twenty feet of the display. Each digit has a brightness code for constructing displays with closely matched digits.

- ONE DIE PER SEGMENT INSURES LOW VOLTAGE DROP OF TYPICALLY 1.7 V_F
- LOW CURRENT REQUIREMENTS OF TYPICALLY 20 mA/SEGMENT
- FITS STANDARD DIP SOCKETS WITH 0.6" PIN ROW
- DECIMAL POINT ON RIGHT OR LEFT SIDE
- MAXIMIZED CONTRAST RATIO WITH INTEGRAL LENS CAP
- HORIZONTAL STACKING 1" TYPICAL
- COMMON CATHODE OR COMMON ANODE

ABSOLUTE MAXIMUM RATINGS

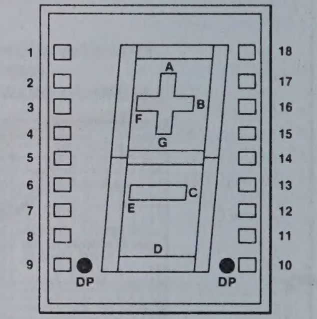
Maximum Temperature and Humidity

Junction Temperature	-25°C to +85°C
Storage Temperature	-25°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity @ 65°C	98%

Maximum Voltage and Currents

V_R	Reverse Voltage	3.0 V
$I_{F(Avg)}$	Avergae Forward Current, Segment or Decimal Point	25 mA
	Derate from 25°C Ambient Temperature (Fig. 2)	0.3 mA/°C
I_{pk}	Peak Current, Segment or Decimal Point (100 µs pulse width) 1000 PPS, T_A = 25°C	200 mA

PIN CONNECTIONS
(TIP VIEW)



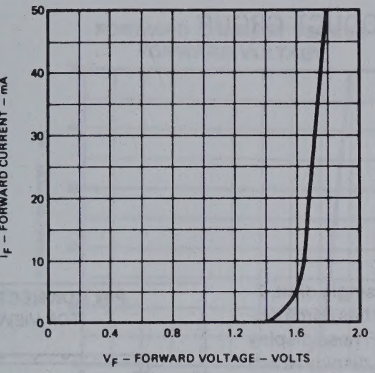
PIN	FND801A FND846A	FND808A FND849A
1	Omitted	Omitted
2	Segment A	Segment A
3	Segment F	Segment F
4	Common Cath.	Common Anode
5	Segment E	Segment E
6	Common Cath.	Common Anode
7	N.C.	N.C.
8	Omitted	Omitted
9	Omitted	Omitted
10	Decimal Point	Decimal Point
11	Segment D	Segment D
12	Common Cath.	Common Anode
13	Segment C	Segment C
14	Segment G	Segment G
15	Segment B	Segment B
16	Omitted	Omitted
17	Common Cath.	Common Anode
18	Omitted	Omitted

ELECTRICAL AND RADIANT CHARACTERISTICS: T_A = 25°C

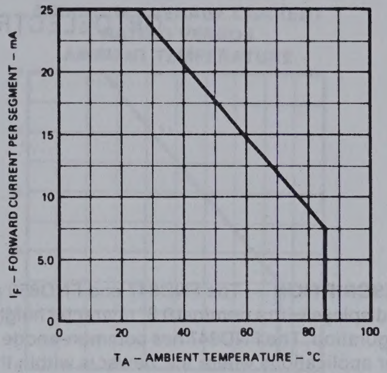
SYMBOL	CHARACTERISTICS	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage	1.5	1.7	2.0	V	I_F = 20 mA
V_R	Reverse Voltage	3.0	12		V	I_R = 1.0 mA
I_O	Axial Luminous Intensity, Each Segment	240	600		µcd	I_F = 20 mA
ΔI_O	Intensity Matching, Segment to Segment		±33		%	I_F = 20 mA
	Intensity Matching, Within One Intensity Class		±15		%	I_F = 20 mA on all segments at once
L_O	Average Segment Lumenance		35		ftL	I_F = 20 mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		+25		degrees	
λ_{pk}	Peak Wavelength		660		nm	I_F = 20 mA

TYPICAL CHARACTERISTIC CURVES

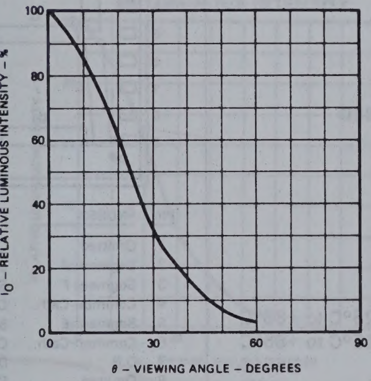
FORWARD CURRENT VERSUS FORWARD VOLTAGE



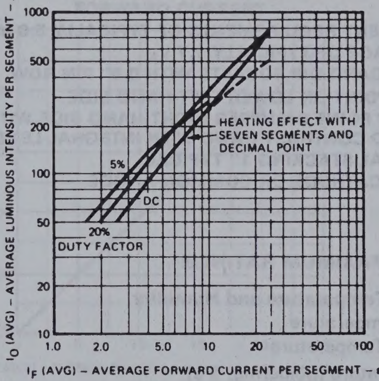
MAXIMUM AVERAGE CURRENT RATING VERSUS AMBIENT TEMPERATURE



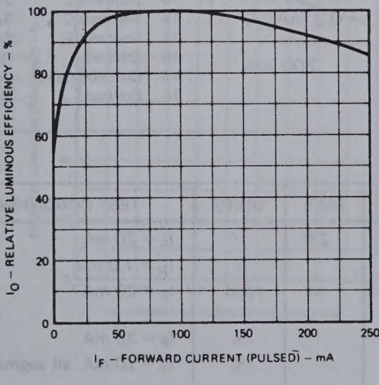
ANGULAR DISTRIBUTION OF LUMINOUS INTENSITY



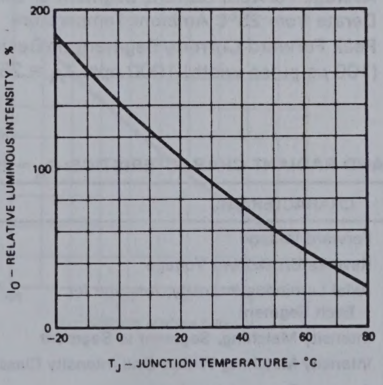
AVERAGE LUMINOUS INTENSITY VERSUS AVERAGE FORWARD CURRENT



RELATIVE LUMINOUS EFFICIENCY (mcd PER mA) VERSUS PEAK CURRENT PER SEGMENT



RELATIVE LUMINOUS INTENSITY VERSUS JUNCTION TEMPERATURE



FND847 • FND850

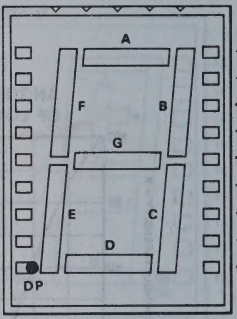
RED GaAsP 0.8 INCH SINGLE DIGIT NUMERIC LED DISPLAY

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION — The FND847 and FND850 are red GaAsP single digit, 7-segment LED displays with a nominal 0.8" character height. The FND850 has common-cathode configuration. The FND847 has common-anode configuration. These display devices are for applications where the viewer is within thirty feet of the display. Each digit has a brightness code (06, 07, 08 . . .) for constructing arrays with closely matched digits.

- **LOW CURRENT REQUIREMENTS OF TYPICALLY 5.0 mA/SEGMENT**
- **LOW VOLTAGE OF TYPICALLY 1.7 V_F**
- **FITS STANDARD DIP SOCKETS WITH 0.6" PIN ROW**
- **DECIMAL POINT ON LOWER LEFT-HAND SIDE**
- **OVERFLOW POINT ON UPPER RIGHT-HAND SIDE WITH DIGIT REVERSED**
- **MAXIMIZED CONTRAST RATIO WITH INTEGRAL LENS CAP**
- **HORIZONTAL STACKING 1" TYPICAL**
- **COMMON-CATHODE OR COMMON-ANODE**

PIN CONNECTIONS
(TOP VIEW)



PIN	FND850	FND847
1	Omitted	Omitted
2	Segment A	Segment A
3	Segment F	Segment F
4	Common-Cath.	Common-Anode
5	Segment E	Segment E
6	Common-Cath.	Common-Anode
7	D.P.	D.P.
8	Omitted	Omitted
9	Omitted	Omitted
10	N.C.	N.C.
11	Segment D	Segment D
12	Common-Cath.	Common-Anode
13	Segment C	Segment C
14	Segment G	Segment G
15	Segment B	Segment B
16	Omitted	Omitted
17	Common-Cath.	Common-Anode
18	Omitted	Omitted

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	−25°C to +85°C
Operating Temperature	−25°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	98%

Maximum Voltage and Currents

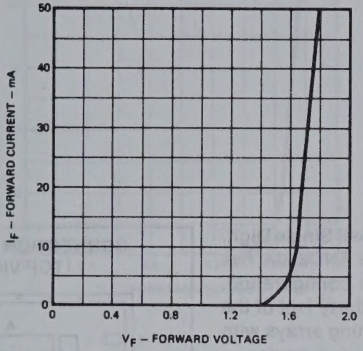
V_R	Reverse Voltage	3.0 V
$I_{F(Avg)}$	Average Forward Current/Segment or Decimal Point Derate from 25°C Ambient Temperature	25 mA 0.3 mA/°C
i_f	Peak Forward Current/Segment or Decimal Point (100 μs pulse width) 1000 pps, T_A = 25°C	200 mA

ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

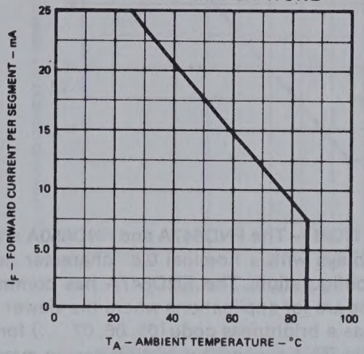
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage	1.5	1.7	2.0	V	I_F = 20 mA
BV_R	Reverse Breakdown Voltage	3.0	12		V	I_R = 1.0 mA
I_O	Axial Luminous Intensity, Average for Each Segment	380	1100		μcd	I_F = 20 mA
ΔI_O	Intensity Matching, Segment to Segment		±33		%	I_F = 20 mA
	Intensity Matching Within One Intensity Class		±20		%	I_F = 20 mA, all segments at once
L_O	Average Segment Luminance		64		ftL	I_F = 20 mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		±25		degrees	
λ_{pk}	Peak Wavelength		665		nm	I_F = 20 mA

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

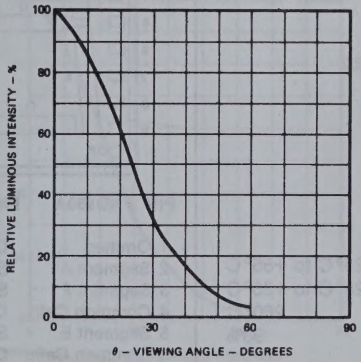
FORWARD CURRENT VERSUS FORWARD VOLTAGE



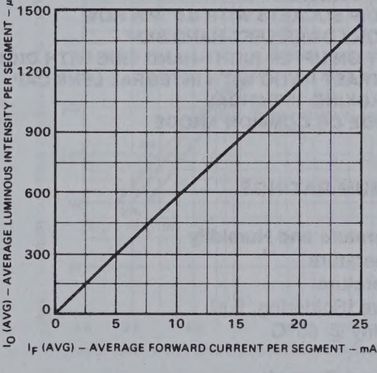
MAXIMUM AVERAGE CURRENT RATING VERSUS AMBIENT TEMPERATURE



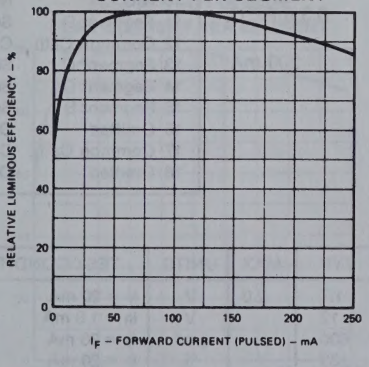
ANGULAR DISTRIBUTION OF LUMINOUS INTENSITY



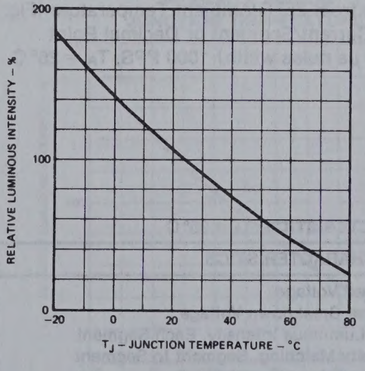
AVERAGE LUMINOUS INTENSITY VERSUS AVERAGE FORWARD CURRENT



RELATIVE LUMINOUS EFFICIENCY (mcd PER mA) VERSUS PEAK CURRENT PER SEGMENT



RELATIVE LUMINOUS INTENSITY VERSUS JUNCTION TEMPERATURE



FND847A • FND850A

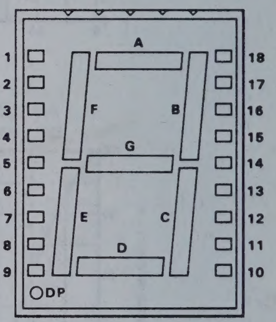
RED GaAsP 0.8 INCH SINGLE DIGIT NUMERIC LED DISPLAY

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION — The FND847A and FND850A are Red GaAsP Single Digit, 7-Segment LED Displays with a nominal 0.8" character height. The FND850A has common cathode configuration. The FND847A has common anode configuration. These display devices are for applications where the viewer is within thirty feet of the display. Each digit has a brightness code (05, 06, 07 . . .) for constructing arrays with closely matched digits. This second-generation design maximizes viewing angle.

- LOW CURRENT REQUIREMENTS OF TYPICALLY 20 mA/SEGMENT
- LOW VOLTAGE OF TYPICALLY 1.7 V_F
- FITS STANDARD DIP SOCKETS WITH 0.6" PIN ROW
- DECIMAL POINT ON LOWER LEFT-HAND SIDE
- OVERFLOW POINT ON UPPER RIGHT-HAND SIDE WITH DIGIT REVERSED
- MAXIMIZED CONTRAST RATIO WITH INTEGRAL LENS CAP
- HORIZONTAL STACKING 1" TYPICAL
- COMMON CATHODE OR COMMON ANODE

CONNECTION DIAGRAM
(TOP VIEW)



PIN	FND850A	FND847A
1	Omitted	Omitted
2	Segment A	Segment A
3	Segment F	Segment F
4	Common Cath.	Common Anode
5	Segment E	Segment E
6	Common Cath.	Common Anode
7	D.P.	D.P.
8	Omitted	Omitted
9	Omitted	Omitted
10	N.C.	N.C.
11	Segment D	Segment D
12	Common Cath.	Common Anode
13	Segment C	Segment C
14	Segment G	Segment G
15	Segment B	Segment B
16	Omitted	Omitted
17	Common Cath.	Common Anode
18	Omitted	Omitted

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Junction Temperature	-25°C to +85°C
Storage Temperature	-25°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity @ 65°C	98%

Maximum Voltage and Currents

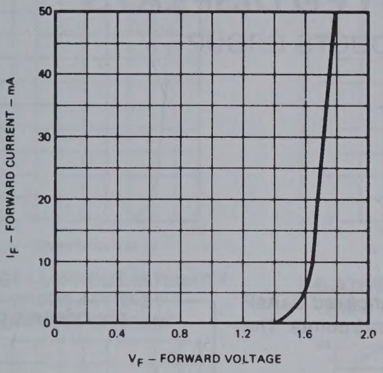
V_R	Reverse Voltage	3.0 V
$I_{F(Avg)}$	Average Forward Current/Segment or Decimal Point	25 mA
	Derate from 25°C Ambient Temperature (Fig. 2)	0.3 mA/°C
I_{pk}	Peak Current/Segment or Decimal Point (100 μs pulse width) 1000 PPS, $T_A = 25°C$	200 mA

ELECTRICAL CHARACTERISTICS: $T_A = 25°C$

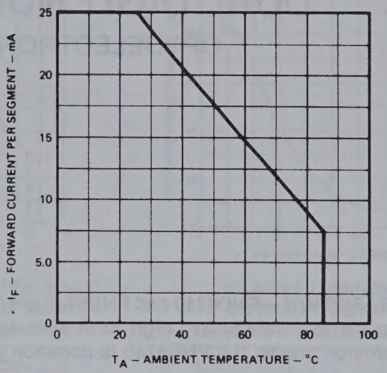
SYMBOL	CHARACTERISTICS	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.7	2.0	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	3.0	12		V	$I_R = 1.0$ mA
I_O	Axial Luminous Intensity, Each Segment	240	600		μcd	$I_F = 20$ mA
ΔI_O	Intensity Matching, Segment to Segment		±33		%	$I_F = 20$ mA
	Intensity Matching, Within One Intensity Class		±20		%	$I_F = 20$ mA on all segments at once
L_O	Average Segment Luminance		35		ftL	$I_F = 20$ mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		30		degrees	
λ_{pk}	Peak Wavelength		665		nm	$I_F = 20$ mA

TYPICAL CHARACTERISTIC CURVES

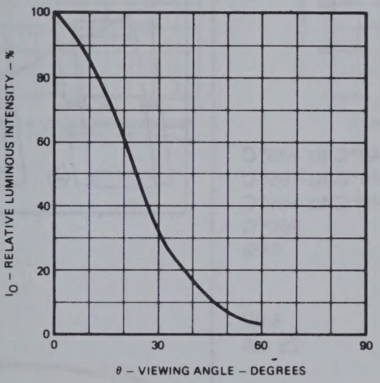
FORWARD CURRENT VERSUS FORWARD VOLTAGE



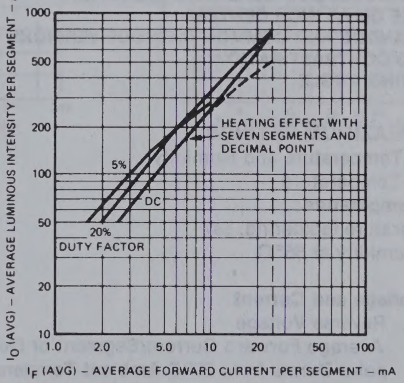
MAXIMUM AVERAGE CURRENT RATIO VERSUS AMBIENT TEMPERATURE



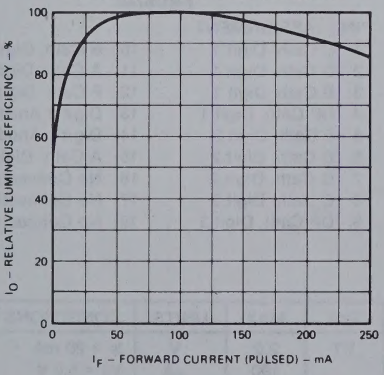
ANGULAR DISTRIBUTION OF LUMINOUS INTENSITY



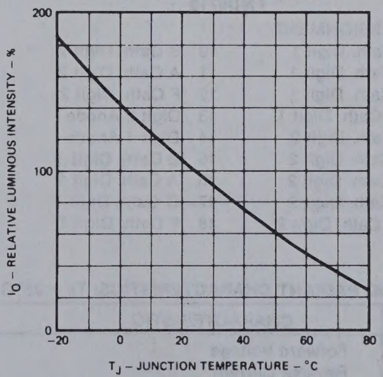
AVERAGE LUMINOUS INTENSITY VERSUS AVERAGE FORWARD CURRENT



RELATIVE LUMINOUS EFFICIENCY (mcd PER mA) VERSUS PEAK CURRENT PER SEGMENT



RELATIVE LUMINOUS INTENSITY VERSUS JUNCTION TEMPERATURE



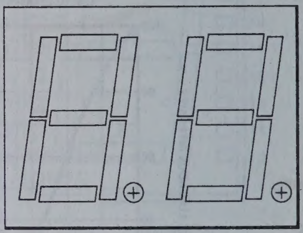
FND6710 • FND6740

RED GaAsP 0.56-INCH
DUAL DIGIT NUMERIC LED DISPLAYS

OPTOELECTRONICS PRODUCTS GROUP

GENERAL DESCRIPTION—FND6710 and FND6740 are high performance red GaAsP 7-segment displays available in two digit form with righthand decimal points. The FND6710 is common anode, the FND6740 is common cathode.

PIN CONNECTIONS



- **PIN COMPATIBLE WITH MAN6700 SERIES AND DL721/727 SERIES**
- **LOW CURRENT REQUIREMENTS - TYPICALLY 8 MA/SEG.**
- **LOW FORWARD VOLTAGE - TYPICALLY 1.7 V**
- **STANDARD DOUBLE DIP LEAD CONFIGURATION**
- **STACKABLE ON 0.5 INCH CENTERS**
- **COMMON-ANODE AND COMMON-CATHODE VERSIONS**
- **MAXIMIZED CONTRAST RATIO**
- **WIDE VIEWING ANGLE**

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity	-40° C to +85° C
Operating Temperature	-40° C to +85° C
Storage Temperature	-40° C to +85° C
Pin Temperature (soldering, 5s)	260° C
Relative Humidity at 65° C	98%

Maximum Voltage and Current

V_R	Reverse Voltage	5.0V
I_F (Avg)	Average Forward Current/Segment or Decimal point Derate from 25° C Ambient Temperature	25 mA
i_f	Peak Current/Segment or Decimal point (100 μs pulse) 1000 pps, $T_A = 25°C$	200 mA

PIN ASSIGNMENT

FND6710

PIN	ASSIGNMENT	PIN	ASSIGNMENT
1	E Cath. Digit 1	10	B Cath. Digit 2
2	D Cath. Digit 1	11	A Cath. Digit 2
3	C Cath. Digit 1	12	F Cath. Digit 2
4	DP Cath. Digit 1	13	Digit 2 Anode
5	E Cath. Digit 2	14	Digit 1 Anode
6	D Cath. Digit 2	15	B Cath. Digit 1
7	G Cath. Digit 2	16	A Cath. Digit 1
8	C Cath. Digit 2	17	G Cath. Digit 1
9	DP Cath. Digit 2	18	F Cath. Digit 1

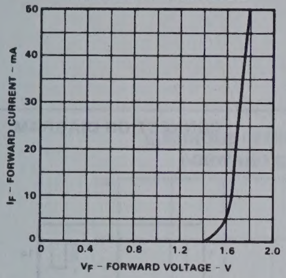
FND6740

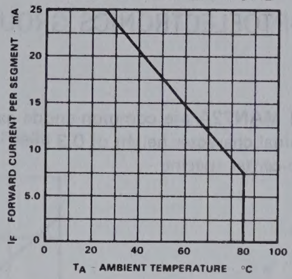
PIN	ASSIGNMENT	PIN	ASSIGNMENT
1	C Cath. Digit 1	10	B Cath. Digit 2
2	D Cath. Digit 1	11	A Cath. Digit 2
3	B Cath. Digit 1	12	F Cath. Digit 2
4	DP Cath. Digit 1	13	Digit 2 Anode
5	E Cath. Digit 2	14	Digit 1 Anode
6	D Cath. Digit 2	15	A Cath. Digit 1
7	G Cath. Digit 2	16	No Connection
8	C Cath. Digit 2	17	No Connection
9	DP Cath. Digit 2	18	No Connection

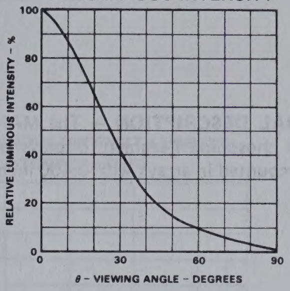
ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$ per digit.

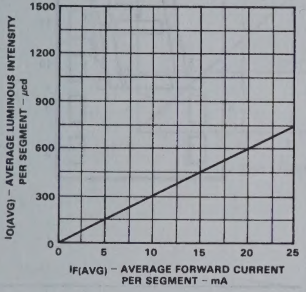
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	CONDITIONS
V_F	Forward Voltage	1.5	1.7	2.0	V	$I_F = 20$ mA
I_R	Reverse Current			100	μA	$V_R = 5.0$ V
ΔI_O	Axial Luminous Intensity, Each Segment	125	250		μcd	$I_F = 10$ mA
I_O	Intensity Matching, segment to segment		±33		%	$I_F = 10$ mA
λpk	Peak Wavelength		665		nm	$I_F = 20$ mA

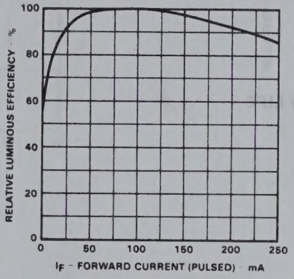
TYPICAL CHARACTERISTIC CURVES

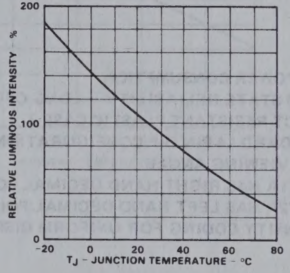

FORWARD CURRENT VERSUS FORWARD VOLTAGE


MAXIMUM AVERAGE CURRENT RATING VERSUS AMBIENT TEMPERATURE


ANGULAR DISTRIBUTION OF LUMINOUS INTENSITY


AVERAGE LUMINOUS INTENSITY VERSUS AVERAGE FORWARD CURRENT


RELATIVE LUMINOUS EFFICIENCY (MCD per mA) VERSUS PEAK CURRENT PER SEGMENT


RELATIVE LUMINOUS INTENSITY VERSUS JUNCTION TEMPERATURE

MAN71A • MAN72A

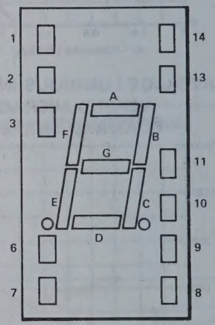
RED GaAsP 0.3 INCH 7-SEGMENT DIGIT

OPTOELECTRONICS GROUP

GENERAL DESCRIPTION – The MAN71A and MAN72A are common-anode gallium arsenide phosphide 7-segment displays with a nominal character height of 0.3 inch. They can be mounted in arrays with 0.400 inch center-to-center spacing.

- **LOW POWER CONSUMPTION**
- **SOLID STATE RELIABILITY – LONG OPERATION LIFE**
- **IMPACT RESISTANT PLASTIC CASE**
- **STANDARD 14-PIN DIP CONFIGURATION**
- **WIDE VIEWING ANGLE**
- **MAN71A HAS RIGHT HAND DECIMAL POINT**
- **MAN72A HAS LEFT HAND DECIMAL POINT**
- **INTENSITY CODING FOR UNIFORM DISPLAYS**

CONNECTION DIAGRAM



PIN NO.	MAN71A	PIN NO.	MAN72A
1	Cathode A	1	Cathode A
2	Cathode F	2	Cathode F
3	Common-anode	3	Common-anode
4	No pin	4	No pin
5	No pin	5	No pin
6	NC	6	Cathode D.P.
7	Cathode E	7	Cathode E
8	Cathode D	8	Cathode D
9	Common-anode	9	NC
10	Cathode C	10	Cathode C
11	Cathode G	11	Cathode G
12	No pin	12	No pin
13	Cathode B	13	Cathode B
14	Common-anode	14	Common-anode

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature		–40°C to +85°C
Operating Temperature		–40°C to +85°C
Pin Temperature (Soldering, 5 s)		260°C
Relative Humidity at 65°C		98%

Maximum Voltage and Currents

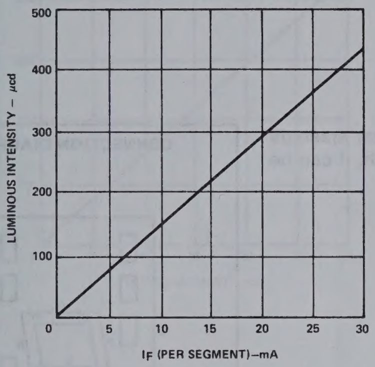
V_R	Reverse Voltage	5.0 V
$I_{F(Avg)}$	Average Forward Current/Segment or Decimal Point	30 mA
	Derate from 25°C Ambient Temperature	2.0 mA/°C
	Peak Forward Current/Segment or Decimal Point (100 μs pulse) 1000 pps, $T_A = 25°C$	200 mA

ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

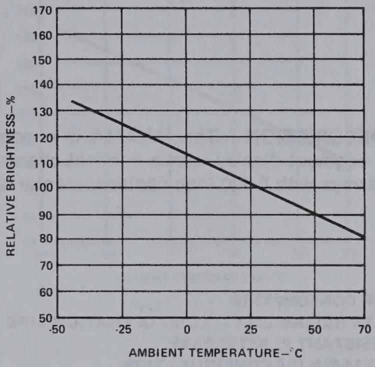
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage, Each Segment		1.6	2.0	V	$I_F = 20$ mA
I_R	Reverse Current, Each Segment			100	μA	$V_R = 5.0$ V
I_O	Axial Luminous Intensity, Each Segment	125	250		μcd	$I_F = 10$ mA
ΔI_O	Intensity Matching, Segment-to-Segment		±33		%	$I_F = 20$ mA
	Intensity Matching Within One Intensity Class		±20		%	$I_F = 20$ mA, all segments at once
λ_{pk}	Peak Wavelength		660		nm	$I_F = 20$ mA

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

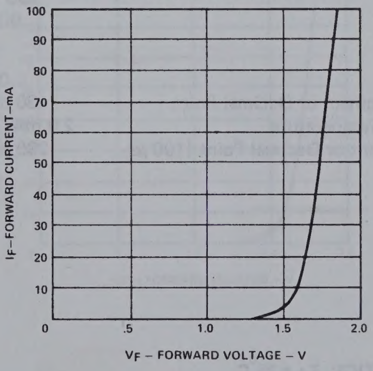
LUMINOUS INTENSITY VERSUS FORWARD CURRENT



LUMINOUS INTENSITY VERSUS TEMPERATURE



FORWARD CURRENT VERSUS FORWARD VOLTAGE



MAN74A

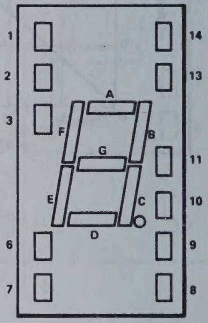
RED GaAsP 0.3 INCH 7-SEGMENT DIGIT

OPTOELECTRONICS GROUP

GENERAL DESCRIPTION — The MAN74A is a common-cathode gallium arsenide phosphide 7-segment display with a nominal character height of 0.3 inch. It can be mounted in arrays with 0.400 inch center-to-center spacing.

- LOW POWER CONSUMPTION
- SOLID STATE RELIABILITY – LONG OPERATION LIFE
- IMPACT RESISTANT PLASTIC CASE
- STANDARD 14-PIN DIP CONFIGURATION
- WIDE VIEWING ANGLE
- **MAN74A HAS RIGHT HAND DECIMAL POINT**
- INTENSITY CODING FOR UNIFORM DISPLAYS

CONNECTION DIAGRAM



PIN NO.	MAN74A
1	Anode F
2	Anode G
3	No pin
4	Common cathode
5	No pin
6	Anode E
7	Anode D
8	Anode C
9	Anode D.P. right hand
10	No pin
11	No pin
12	Common cathode
13	Anode B
14	Anode A

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	–40°C to +85°C
Operating Temperature	–40°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	98%

Maximum Voltage and Currents

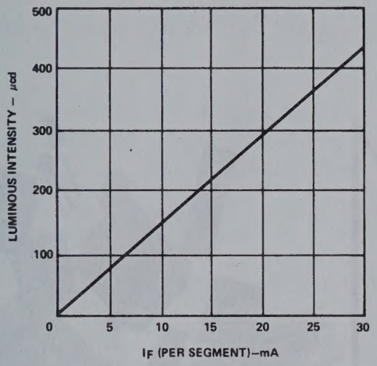
V_R	Reverse Voltage	5.0 V
$I_{F(Avg)}$	Average Forward Current/Segment or Decimal Point	30 mA
	Derate from 25°C Ambient Temperature	2.0 mA/°C
	Peak Forward Current/Segment or Decimal Point (100 μs pulse) 1000 pps, T_A = 25°C	200 mA

ELECTRICAL AND RADIANT CHARACTERISTICS: $T_A = 25°C$

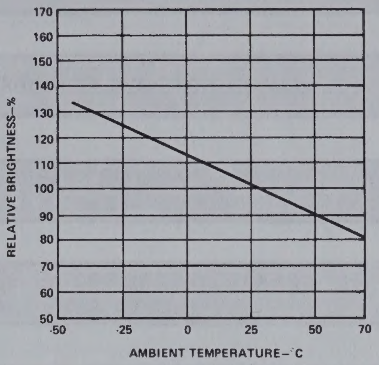
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage, Each Segment		1.6	2.0	V	I_F = 20 mA
I_R	Reverse Current, Each Segment			100	μA	V_R = 5.0 V
I_O	Axial Luminous Intensity, Each Segment	125	250		μcd	I_F = 10 mA
ΔI_O	Intensity Matching, Segment-to-Segment		±33		%	I_F = 20 mA
	Intensity Matching Within One Intensity Class		±20		%	I_F = 20 mA, all segments at once
λ_{pk}	Peak Wavelength		660		nm	I_F = 20 mA

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

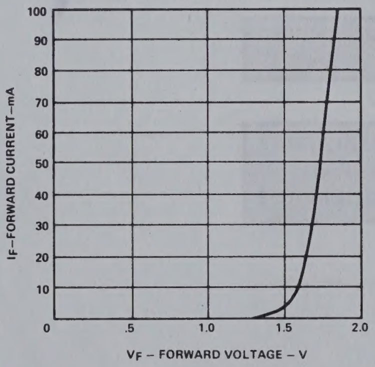
LUMINOUS INTENSITY VERSUS FORWARD CURRENT

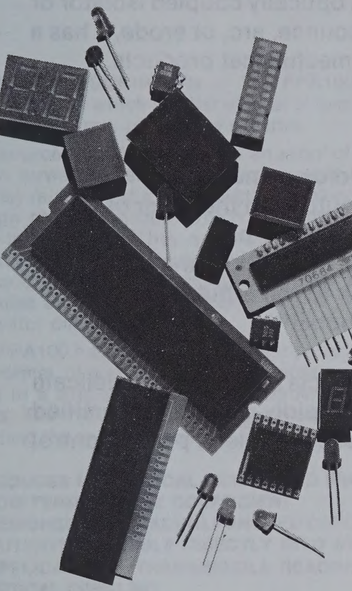


LUMINOUS INTENSITY VERSUS TEMPERATURE



FORWARD CURRENT VERSUS FORWARD VOLTAGE





OPTOELECTRONIC TECHNOLOGY 1

DISCRETE LED DIGIT RELIABILITY 2

VISIBLE LED LAMPS AND MOUNTING HARDWARE 3

SEVEN-SEGMENT DISPLAYS AND DISPLAY ARRAYS 4

PHOTOTRANSISTORS, INFRARED EMITTERS, AND SENSORS 5

PHOTOCOUPLERS 6

PACKAGE OUTLINES 7

DEFINITIONS OF SYMBOLS AND TERMS 8

FAIRCHILD FIELD SALES OFFICES, SALES REPRESENTATIVES AND DISTRIBUTOR LOCATIONS 9

CHAPTER 5
INTRODUCTION

A photocoupler consists basically of a light-emitting photodiode and a light-sensitive semiconductor detector, optically coupled to enable an optical signal to be transmitted from the emitter to the detector. This optical transmission of the signal enables electrical isolation of several thousands of volts to be achieved between input and output of the photocoupler.

Since the photocoupler (also sometimes referred to as an optically coupled isolator or optocoupler) has no moving parts, such as contacts, to bounce, arc, or erode, it has a considerably increased reliability factor over equivalent mechanical products.

Important features of the photocoupler are:

On-and-off switching speed in the one-to two-microsecond region.
Electrical isolation resistance between input and output on the order of 10^{11} ohms, and coupling capacitance of approximately 1 pF.
Data transmission rates from dc through the MHz frequency ranges.
Provide unidirectional operation with no feedback to the input.
Directly interface with other semiconductor components.

The ability of the photocoupler to isolate such sensitive objects as people and delicate instruments from high voltage equipment is generating a rapidly growing, diversified market in such areas as medical monitors, electrostatic paper copiers, power control equipment, and telecommunications systems.

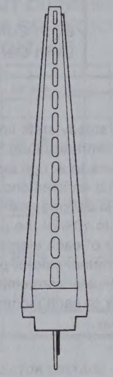
FPA100 • FPA101 • FPA102
EMITTER AND SENSOR MATCHED PAIR ARRAYS
OPTOELECTRONICS PRODUCT GROUP

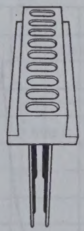
GENERAL DESCRIPTION — The FPA100, FPA101 and FPA102 are source/sensor arrays each of which consist of a set of two modules: one, an array of infrared emitters and two, an array of infrared sensors.

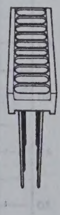
The source module consists of an array of gallium arsenide infrared emitting diodes. When forward biased, these diodes emit an intense narrow band of infrared (non-visible) radiation at a wavelength of 900 nm. The sensor modules consist of an array of npn phototransistors which are sensitive to visible as well as infrared radiation (400 to 1100 nm). They are most sensitive to infrared radiation so that the source module's emission wavelength is very nearly perfect for maximum coupling efficiency. The source and sensor modules of each set are identical in construction; when the modules are placed facing one another, each infrared emitting diode has a phototransistor directly opposite it.

The FPA100 has nine source/sensor pairs in a single line on 0.100″ centers, matching the format of standard punched paper tape. The FPA101 has twelve source/sensor pairs in a single line on 0.250″ centers, matching the row spacing of standard tab cards. The FPA102 has ten source/sensor pairs in a single line on 0.087″ centers, matching the column spacing of standard tab cards.

- **REDUCES MECHANICAL DESIGN AND PACKAGING PROBLEMS**
- **LOW TEMPERATURE COEFFICIENT**
- **DESIGNED FOR READING PUNCHED CARDS AND PUNCHED TAPES WITH THE SENSOR OUTPUTS OPERABLE DIRECTLY INTO STANDARD DIGITAL INTEGRATED CIRCUITS.**
- **APPLICATIONS: TRANSMISSILE READING SHAFT ENCODING AND MULTI-CHANNEL OPTICAL COUPLING**


FPA101


FPA100


FPA102

ABSOLUTE MAXIMUM RATINGS

Maximum Temperatures and Humidity

Storage Temperature	−40°C to +100°C
Operating Temperature	−40°C to +100°C
Pin Temperature (Soldering, 10 s)	260°C
Relative Humidity at 65°C	98 %

Maximum Power Dissipation (Note 1)

Total Dissipation at T_A = 25°C for Source Array	110 mW/cell
Derate Linearly from 25°C	1.47mW/°C
Total Dissipation at T_A = 25°C for Sensor Array	167mW/cell
Derate Linearly from 25°C	2.22 mW/°C

Maximum Voltages and Currents

Source Array

I_F	Forward dc Current/Cell	75 mA
V_R	Reverse Voltage	3.0 V

Sensor Array

$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage (Note 2)	12 V
I_C	Collector Current	25 mA

ELECTRICAL CHARACTERISTICS: T_A = 25°C
SOURCE ARRAY

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.25	1.50	V	I_F = 50 mA
BV_R	Reverse Breakdown Voltage	3.0	6.0		V	I_R = 100 μA

SENSOR ARRAY

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
$V_{CEO(sus)}$	Sustaining Voltage (Notes 2 and 3)	12	20		V	I_C = 1.0 mA, (pulsed)
BV_{ECO}	Emitter to Collector Breakdown Voltage (Note 2)		5.0		V	I_{EC} = 100 μA
$V_{CE(sat)}$	Saturation Voltage (Note 4)		0.4		V	I_C = 4 mA, H = 10 mW/cm² (GaAs)
I_{CEO}	Collector Dark Current (Note 2)		10	100	nA	V_{CE} = 5.0 V, H ≤ 0.1 μW/cm²
$I_{CE(lt)}$	Photo Current (Note 4)		4.5		mA	V_{CE} = 5.0 V, H = 1.0 mW/cm² (GaAs)

COMBINATION SOURCE/SENSOR ARRAY

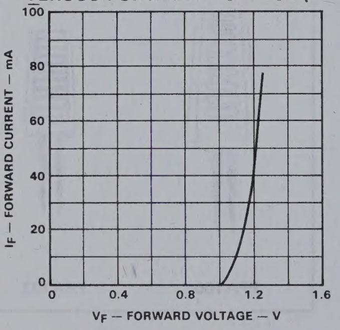
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
I_{OUT}	Output Current	4.5	9.0	13.5	mA	I_{IN} = 50 mA, d = .050", V_{CE} = 5.0 V
$\frac{I_{OUT\ min}}{I_{OUT\ max}}$	Matching Factor	0.5	0.65			I_{IN} = 50 mA, d = .050", V_{CE} = 5.0 V
$V_{CE(sat)}$	Saturation Voltage		0.4	0.7	V	I_{IN} = 50 mA, d = .050", I_{OUT} = 3.7 mA
t_r	Light Current Fall Time (Note 5)		40		μs	I_{IN} = 50 mA, d = .050"
t_f	Light Current Rise Time (Note 5)		40		μs	I_{IN} = 50 mA, d = .050"

NOTES:

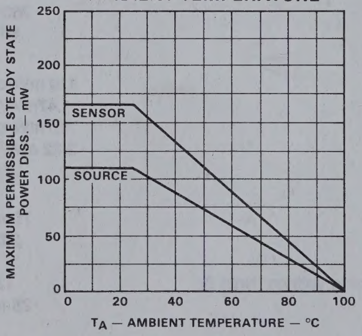
1. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
2. Measured with radiation flux intensity of less than .1 μW/cm² over the spectrum from 0.1 micron to 1.5 microns.
3. Rating refers to a high current point where collector to emitter voltage is lowest.
4. Measured at an irradiance of 5.0 mW/cm² as emitted from a gallium arsenide diode.
5. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of the peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of the peak value.
6. The center of each element is aligned to ±.010" along the length and ±.005" across the width.
7. Emitter terminal side of phototransistor (sensor array) or anode terminal side of diode (source array) defined by white dot.
8. Leads alternate from emitter to collector (sensor) or anode to cathode (source), beginning from this end of the package.
9. The center of each element is aligned to ±.010" across the width and ±.005" along the length.

TYPICAL CHARACTERISTIC CURVES

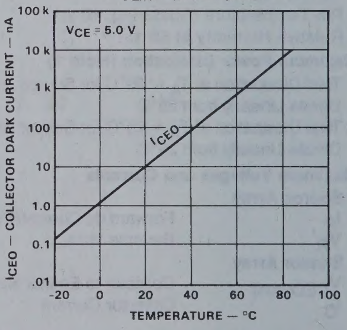
FORWARD CURRENT VERSUS FORWARD VOLTAGE (D.C.)



MAXIMUM P_D VERSUS AMBIENT TEMPERATURE

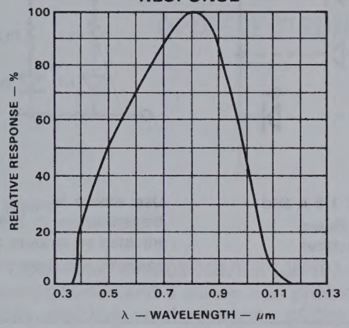


COLLECTOR DARK CURRENT VERSUS TEMPERATURE

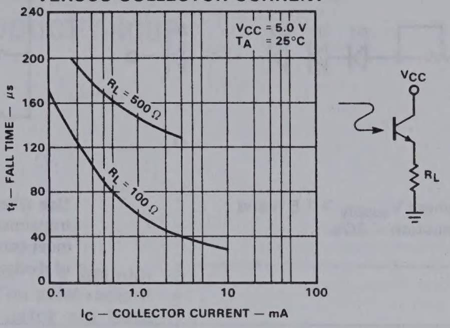


TYPICAL CHARACTERISTIC CURVES (Cont'd)

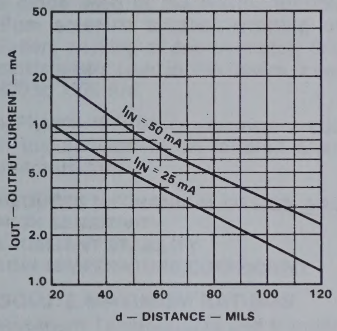
RELATIVE SPECTRAL RESPONSE



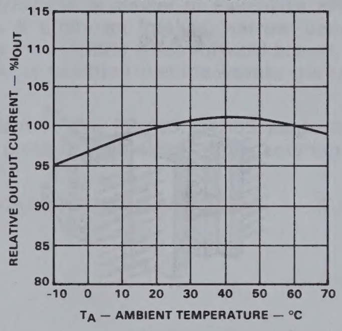
RISE AND FALL TIME VERSUS COLLECTOR CURRENT



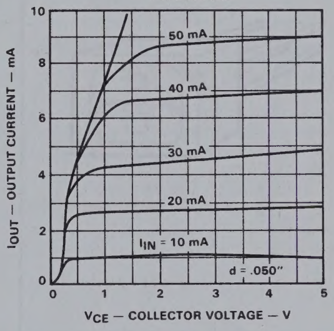
OUTPUT CURRENT VERSUS DISTANCE



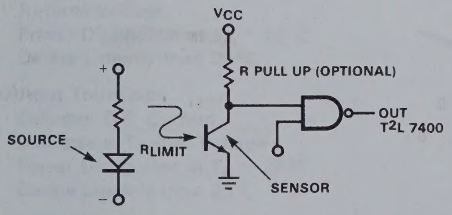
RELATIVE OUTPUT VERSUS AMBIENT TEMPERATURE

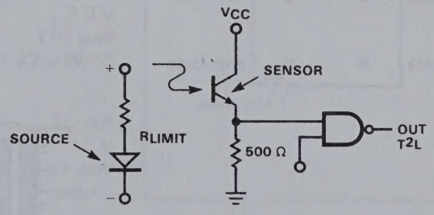


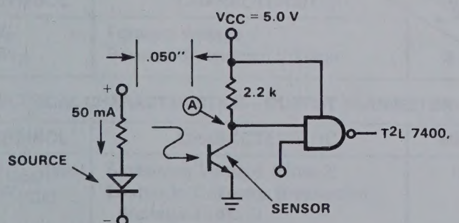
OUTPUT CURRENT VERSUS COLLECTOR VOLTAGE



TYPICAL CIRCUITS

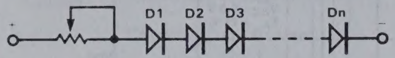

VCC
+
R PULL UP (OPTIONAL)
OUT
T²L 7400
SOURCE
RLIMIT
SENSOR
-


VCC
+
SENSOR
SOURCE
RLIMIT
500 Ω
OUT
T²L
-

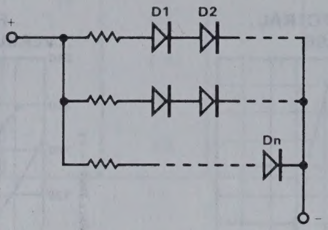

VCC = 5.0 V
.050"
+
50 mA
2.2 k
A
T²L 7400.
SOURCE
SENSOR
-

For a "hole" condition, point A for all sensors will be less than 0.8 V. For a "no hole" condition (where signal due to tape transmission is ≤ 15% of "hole"), point A will be greater than 2.0 V. These are the worst case conditions required to switch this type of logic.

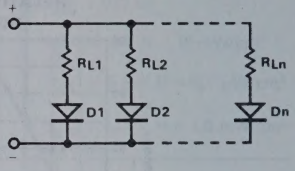
SOURCE CIRCUITS



Use where $V_{supply} > 1.5$ n and transmission < 20%.



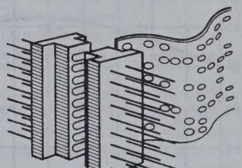
Use where $V_{supply} < 1.5$ n and transmission < 20%. Rows must contain equal number of diodes.



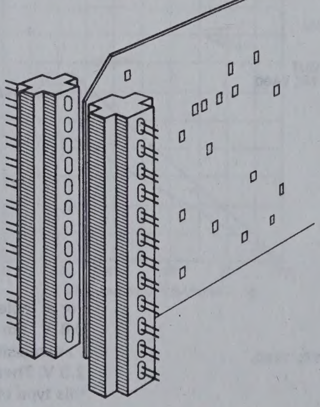
Use where $V_{supply} < 1.5$ n and transmission > 20%. R_L may be adjusted so outputs of sensors are perfectly matched.

TYPICAL APPLICATION

FPA100



FPA101



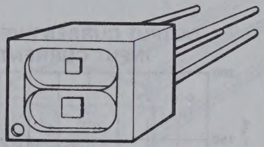
FPA103 • FPA104 • FPA105
FPA106 • FPA107 • FPA108
LIGHT REFLECTION EMITTER/SENSOR ARRAY
OPTOELECTRONICS PRODUCT GROUP

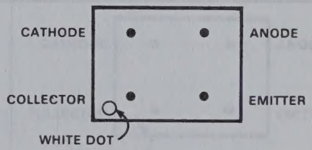
GENERAL DESCRIPTION—The FPA103/104/105/106/107/108 consists of a gallium arsenide infrared emitting diode and a silicon npn phototransistor. The axial radiant intensity of the diode and the axial response of the phototransistor are both perpendicular to the face of the device. The phototransistor thus responds to radiation emitted from the diode only when a reflective object or surface is in the field of view of the phototransistor.

The diode used in the FPA103/104/105/106/107/108 is similar to Fairchild's FPE100 gallium arsenide infrared emitting diode. It emits an intense, narrow band of radiation, peaking at approximately 900 nm (non-visible) when forward biased. The phototransistor used in this device is sensitive to radiation over the wavelength range of 400 to 1100 nm.

The FPA106/107/108 is electrically equivalent to the FPA103/104/105 respectively with the addition of an infrared filter to prevent visible light from entering the phototransistor.

- **REDUCES MECHANICAL DESIGN AND PACKAGING PROBLEMS**
- **HIGH SENSITIVITY**
- **EXCELLENT STABILITY**
- **LOW TEMPERATURE COEFFICIENT**





CONNECTION DIAGRAM
(TOP VIEW)

ABSOLUTE MAXIMUM RATINGS

Maximum Temperatures and Humidity	
Storage Temperature	−40°C to +100°C
Operating Temperature	−40°C to +100°C
Pin Temperature (Soldering, 10 s)	260°C
Relative Humidity at 65°C	98%
Input Diode	
Forward D.C. Current	75 mA
Reverse Voltage	3.0 V
Power Dissipation at T_A = 25°C	110 mW
Derate Linearly from 25°C	1.47 mW/°C
Output Transistor	
Collector D.C. Current	25 mA
Collector to Emitter Voltage	12 V
Power Dissipation at T_A = 25°C	167 mW
Derate Linearly from 25°C	2.22 mW/°C

ELECTRICAL CHARACTERISTICS—INPUT DIODE: T_A = 25°C

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.25	1.5	V	I_F = 50 mA
BV_R	Reverse Breakdown Voltage	3.0	6.0		V	I_R = 100 μA

ELECTRICAL CHARACTERISTICS—OUTPUT TRANSISTOR: T_A = 25°C

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
$V_{CEO}(sus)$	Sustaining Voltage (Note 2)	12	20		V	I_C = 1.0 mA (pulsed)
BV_{ECO}	Emitter to Collector Breakdown Voltage (Note 2)		5.0		V	I_{EC} = 100 μA

ELECTRICAL CHARACTERISTICS — COMBINATION: $T_A = 25°C$

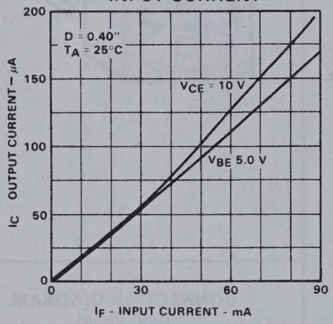
SYMBOL	CHARACTERISTICS	MIN	TYP	MAX	UNITS	TEST CONDITIONS
I_C	Photo Current (GaAs Source, Note 1)					$I_F = 50$ mA, $V_{CE} = 5.0$ V, d = 0.40″
	103 - 106	20	80		µA	
	104 - 107	60		180	µA	
	105 - 108	80		160	µA	
I_{CEO}	Collector Dark Current (Note 2)		10	100	nA	$I_F = 50$ mA, $V_{CE} = 5.0$ V, Non-reflecting external surface
$V_{CE(sat)}$	Saturation Voltage (Note 1)		0.3	0.7	V	$I_F = 50$ mA, $I_C = 5.0$ µA, d = 0.40″
t_r & t_f	Rise & Fall Time (Note 3)		100		µs	$I_C = 80$ µA, $V_{CC} = 5.0$ V, $R_L = 1$ kΩ

NOTE:

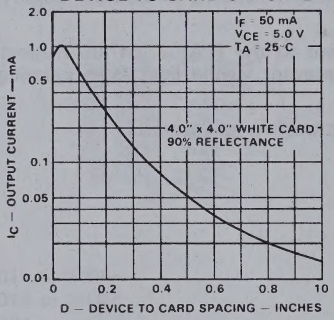
1. Photocurrent is that obtained from a 4.0″ x 4.0″ 90% white surface placed at a distance of .40″ from the face of the device. For test purposes, an Eastman Kodak neutral white test card with 90% diffuse reflectance was employed.
2. Measured with radiation flux intensity of less than .1 µW/cm² over the spectrum from 0.1 micron to 1.5 microns.
3. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of the peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of the peak value.
4. White dot defines collector of phototransistor. Read pinout clockwise, top view; collector, source cathode, source anode, emitter.

TYPICAL ELECTRICAL CHARACTERISTICS

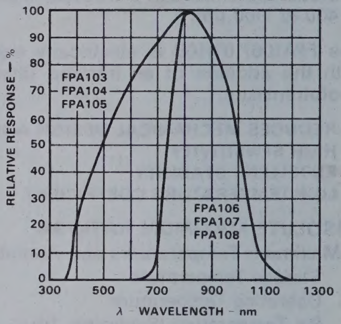
OUTPUT CURRENT VERSUS INPUT CURRENT



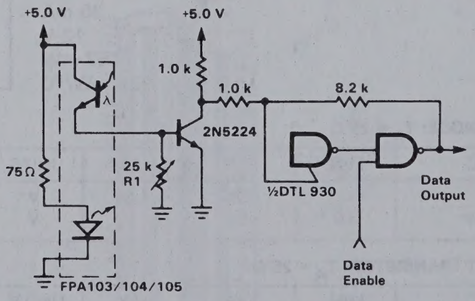
OUTPUT CURRENT VERSUS DEVICE TO CARD SPACING



SPECTRAL CHARACTERISTICS



INTERFACING CIRCUIT



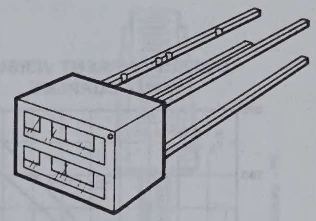
FPA103A • FPA104A • FPA105A
FPA106A • FPA107A • FPA108A
LIGHT REFLECTION EMITTER/SENSOR ARRAYS
OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION — The FPA103A/104A/105A/106A/107A/108A consists of a gallium arsenide infrared emitting diode and a silicon npn phototransistor. The axial radiant intensity of the diode and the axial response of the phototransistor are both perpendicular to the face of the device. The phototransistor thus responds to radiation emitted from the diode only when a reflective object or surface is in the field of view of the phototransistor.

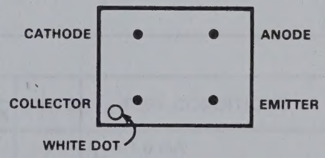
The diode used in the FPA103A/104A/105A/106A/107A/108A is similar to Fairchild's FPE100 gallium arsenide infrared emitting diode. It emits an intense, narrow band of radiation, peaking at approximately 900 nm (non-visible) when forward biased. The phototransistor used in this device is sensitive to radiation over the wavelength range of 400 to 1100 nm.

The FPA106A/107A/108A is electrically equivalent to the FPA103A/104A/105A respectively with the addition of an infrared filter to prevent visible light from entering the phototransistor.

- **REDUCES MECHANICAL DESIGN AND PACKAGING PROBLEMS**
- **HIGH SENSITIVITY**
- **EXCELLENT STABILITY**
- **LOW TEMPERATURE COEFFICIENT**
- **EXCELLENT CROSS-TALK CHARACTERISTICS**



CONNECTION DIAGRAM
(TOP VIEW)



ABSOLUTE MAXIMUM RATINGS

Maximum Temperatures and Humidity	
Storage Temperature	-40° C to +100° C
Operating Temperature	-40° C to +100° C
Pin Temperature (Soldering, 10 s)	260° C
Relative Humidity at 65° C	98%
Input Diode	
Forward D.C. Current	75 mA
Reverse Voltage	3.0 V
Power Dissipation at T_A = 25° C	110 mW
Derate Linearly from T_A = 25° C	1.47 mW/° C
Output Transistor	
Collector D.C. Current	25 mA
Collector to Emitter Voltage	12 V
Power Dissipation at T_A = 25° C	167 mW
Derate Linearly from T_A = 25° C	2.22 mW/° C

ELECTRICAL CHARACTERISTICS — INPUT DIODE: T_A = 25° C

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.25	1.5	V	I_F = 50 mA
BV_R	Reverse Breakdown Voltage	3.0	6.0		V	I_R = 100μA

ELECTRICAL CHARACTERISTICS — OUTPUT TRANSISTOR: T_A = 25° C

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{CEO}(sus)	Sustaining Voltage (Note 2)	12	20		V	I_C = 1.0 mA (pulsed)
BV_{ECO}	Emitter to Collector Breakdown Voltage (Note 2)		5.0		V	I_{EC} = 100 μA

ELECTRICAL CHARACTERISTICS — COMBINATION: $T_A = 25°C$

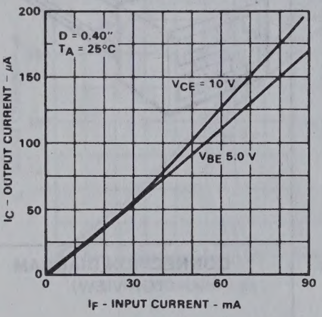
SYMBOL	CHARACTERISTICS	MIN	TYP	MAX	UNITS	TEST CONDITIONS
I_C	Photo Current (GaAs Source, Note 1)					$I_F = 50$ mA, $V_{CE} = 5.0$ V, d = 0.040"
	103A - 106A	100	300		μA	
	104A - 107A	250		750	μA	
	105A - 108A	300		600	μA	
I_{CEO}	Collector Dark Current (Note 2)		10	100	nA	$I_F = 50$ mA, $V_{CE} = 5.0$ V, Non-reflecting external surface
$V_{CE(sat)}$	Saturation Voltage (Note 1)		0.3	0.7	V	$I_F = 50$ mA, $I_C = 5.0$ μA, d = 0.40"
t_r & t_f	Rise & Fall Time (Note 3)		100		μs	$I_C = 80$ μA, $V_{CC} = 5.0$ V, $R_L = 1$ kΩ

NOTE:

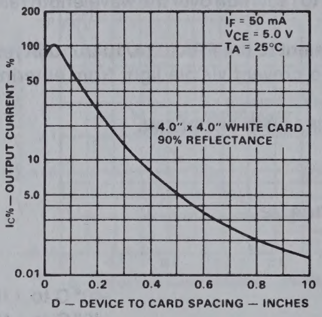
1. Photocurrent is that obtained from a 4.0" x 4.0" 90% white surface placed at a distance of .40" from the face of the device. For test purposes, an Eastman Kodak neutral white test card with 90% diffuse reflectance was employed.
2. Measured with radiation flux intensity of less than .1 μW/cm2 over the spectrum of 0.1 micron to 1.5 microns.
3. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of the peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of the peak value.
4. White dot defines collector of phototransistor. Read pinout clockwise, top view; collector, source cathode, source anode, emitter.

TYPICAL ELECTRICAL CHARACTERISTICS

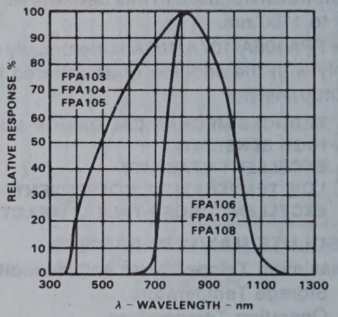
OUTPUT CURRENT VERSUS INPUT CURRENT



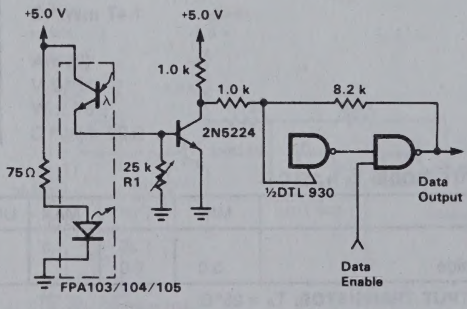
OUTPUT CURRENT VERSUS DEVICE TO CARD SPACING



SPECTRAL CHARACTERISTICS



INTERFACING CIRCUIT



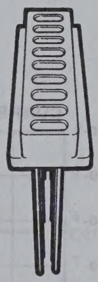
FPA700 • FPA700A

9-ELEMENT PHOTOTRANSISTOR TAPE READER ARRAY

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION — The FPA700 and FPA700A are 9-element npn Planar* phototransistor arrays having exceptionally stable characteristics and high illumination sensitivity. Each transistor is electrically isolated and mounted on 100 mil centers. The case is a plastic compound with transparent resin encapsulation which exhibits stable characteristics under high humidity conditions.

- **HIGH ILLUMINATION SENSITIVITY**
- **EXHIBITS STABLE CHARACTERISTICS UNDER HIGH HUMIDITY**
- **ESPECIALLY DESIGNED FOR PUNCHED OR MARKED CARD READING AND OPTICAL ENCODER APPLICATIONS**



FPA700/700A

ABSOLUTE MAXIMUM RATINGS

Maximum Temperatures and Humidity

Storage Temperature	−40°C to +100°C
Operating Temperature	−40°C to +85°C
Pin Temperature (Soldering, 10 s)	260°C
Relative Humidity at 65°C	98%

Maximum Power Dissipation per Cell

Total Dissipation at T_C = 25°C	200 mW
Derate Linearly from 25°C	3.33 mW/°C
Total Dissipation at T_A = 25°C	133 mW
Derate Linearly from 25°C	2.22 mW/°C

Maximum Voltages and Currents (Note 1)

$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage	20 V
I_C	Collector Current	25 mA

ELECTRICAL CHARACTERISTICS: T_A = 25°C

SYMBOL	CHARACTERISTIC	FPA700			FPA700A			UNITS	TEST CONDITIONS
		MIN	TYP	MAX	MIN	TYP	MAX		
$V_{CEO(sus)}$	Collector-Emitter Sustaining Voltage (Note 2)	20	35		20	35		V	I_C = 1.0 mA
BV_{ECO}	Emitter-Collector Breakdown Voltage (Note 2)		7.0			7.0		V	I_{EC} = 100 μA
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage		0.16	0.33		0.16	0.33	V	I_C = 500 μA, H = 20 mW/cm²
I_{CEO}	Collector Dark Current/Cell (Note 2)		4.0	100		4.0	100	nA	V_{CE} = 5.0 V
$I_{CE(lt)}$	Photo Current, Tungsten Source (Note 3)	200	750		200	750		μA	V_{CE} = 5.0 V, H = 5 mW/cm²
$I_{CE(lt)}$	Photo Current, Tungsten Source (Note 3)		1.75			1.75		mA	V_{CE} = 5.0 V, H = 10 mW/cm²
$I_{CE(lt)}$	Photo Current, GaAs Source (Note 4)		2.25			2.25		mA	V_{CE} = 5.0 V, H = 5 mW/cm²
t_r	Light Current Rise Time (Note 6)		4.0			4.0		μs	GaAs, I_C = 2.0 mA,
t_f	Light Current Fall Time (Note 6)		4.0			4.0		μs	R_L = 100 Ω, V_{CC} = 5.0V
S_{min}/S_{max}	Matching Factor (Notes 3 and 5)	0.5	0.65	1.0	0.75	0.85	1.0		V_{CE} = 5.0 V, H = 5 mW/cm²

*Planar is a patented Fairchild process.

TYPICAL CHARACTERISTIC CURVES

PHOTO CURRENT CHARACTERISTICS

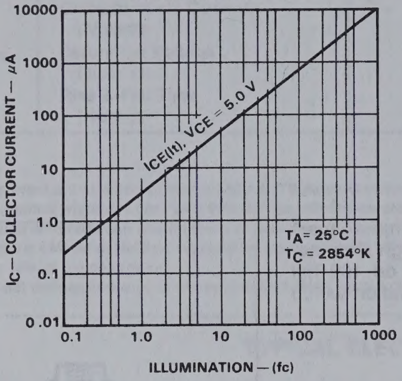
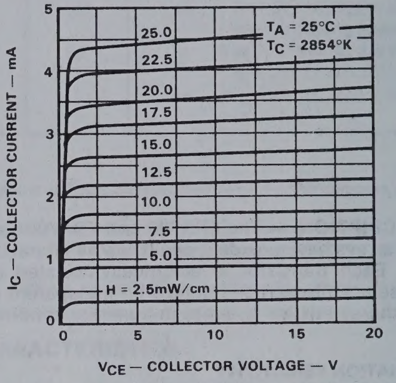
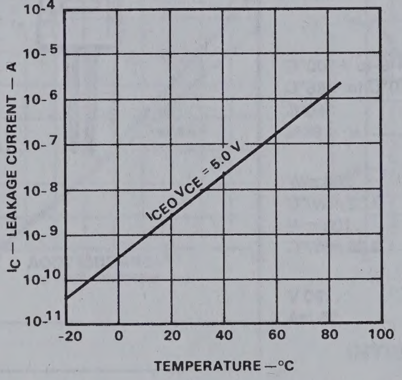


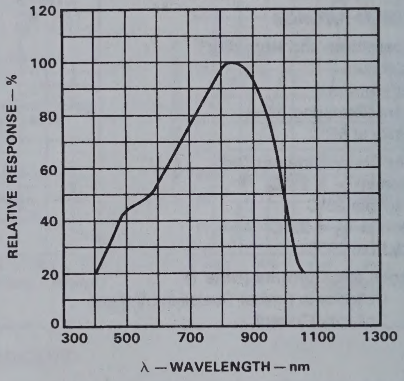
PHOTO CURRENT VERSUS COLLECTOR



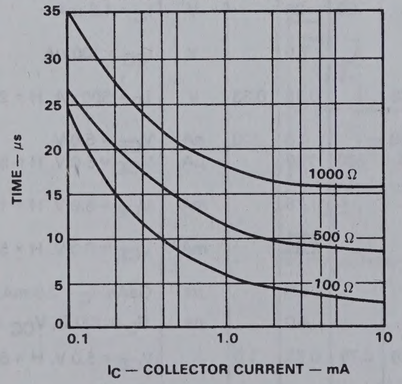
COLLECTOR DARK CURRENT VERSUS TEMPERATURE



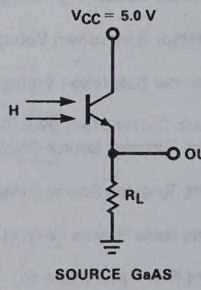
RELATIVE SPECTRAL RESPONSE



RISE AND FALL TIME VERSUS COLLECTOR CURRENT

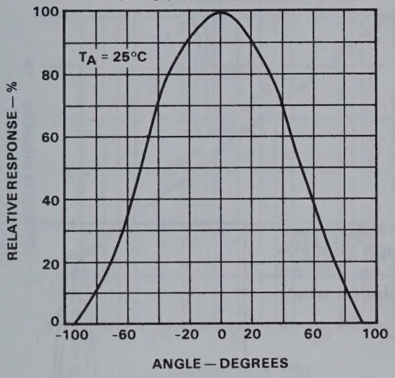


SWITCHING CIRCUIT FOR RISE AND FALL TIMES

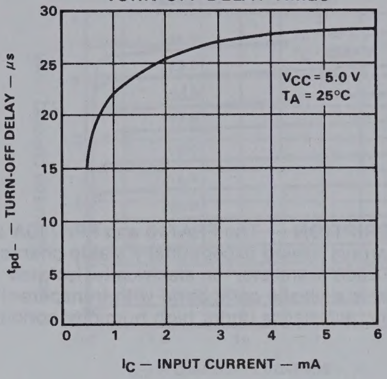


TYPICAL CHARACTERISTIC CURVES (Cont'd)

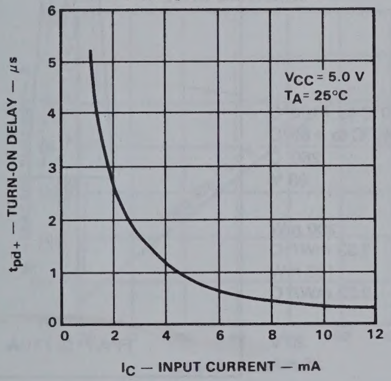
ANGULAR RESPONSE



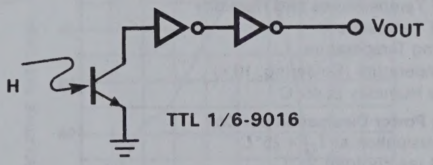
TURN-OFF DELAY TIMES



TURN-ON DELAY TIMES



CIRCUIT FOR TURN-ON AND TURN-OFF DELAY



NOTES:

1. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
2. Measured with radiation flux intensity of less than .1 μW/cm² over the spectrum from 0.1 micron to 1.5 microns.
3. Measured at noted irradiance as emitted from a tungsten lamp at a color temperature of 2854°K. The effective photosensitive area is (0.8 mm²). Illuminance (in lumens/ft²) = irradiance H (in mW/cm²) x 20 at a color temperature of 2854°K.
4. Measured at an irradiance of 5.0 mW/cm² as emitted from a gallium arsenide diode.
5. Matching factor is the ratio of minimum sensitivity to maximum sensitivity of any two cells.
6. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of the peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of the peak value.
7. The center of each element is aligned to ±.010" along the length and ±.005" across the width.
8. Emitter terminal side of phototransistor (sensor array) or anode terminal side of diode (source array) defined by white dot.

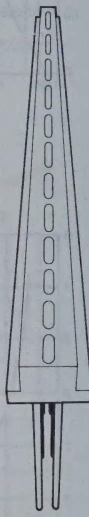
FPA710 • FPA710A

12-ELEMENT PHOTOTRANSISTOR CARD READER ARRAY

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION — The FPA710 and FPA710A are 12-element npn Planar* phototransistor arrays having exceptionally stable characteristics and high illumination sensitivity. Each transistor is electrically isolated and mounted on 250 mil centers. The case is a plastic compound with transparent resin encapsulation which exhibits stable characteristics under high humidity conditions.

- **HIGH ILLUMINATION SENSITIVITY**
- **ESPECIALLY DESIGNED FOR PUNCHED OR MARKED CARD READING AND OPTICAL ENCODER APPLICATIONS**



FPA710/710A

ABSOLUTE MAXIMUM RATINGS

Maximum Temperatures and Humidity

Storage Temperature	−40°C to +100°C
Operating Temperature	−40°C to +85°C
Pin Temperature (Soldering, 10 s)	260°C
Relative Humidity at 65°C	98 %

Maximum Power Dissipation per Cell

Total Dissipation at T_C = 25°C	200 mW
Derate Linearly from 25°C	3.33 mW/°C
Total Dissipation at T_A = 25°C	133 mW
Derate Linearly from 25°C	2.22 mW/°C

Maximum Voltages and Currents (Note 1)

$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage	20 V
I_C	Collector Current	25 mA

ELECTRICAL CHARACTERISTICS: T_A = 25°C

SYMBOL	CHARACTERISTIC	FPA710 MIN	FPA710 TYP	FPA710 MAX	FPA710A MIN	FPA710A TYP	FPA710A MAX	UNITS	TEST CONDITIONS
$V_{CEO(sus)}$	Collector-Emitter Sustaining Voltage (Note 2)	20	35		20	35		V	I_C = 1.0 mA (pulsed)
BV_{ECO}	Emitter-Collector Breakdown Voltage (Note 2)		7.0			7.0		V	I_{EC} = 100 µA
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage		0.16	0.33		0.16	0.33	V	I_C = 500 µA, H = 20 mW/cm²
I_{CEO}	Collector Dark Current (Note 2)		4.0	100		4.0	100	nA	V_{CE} = 5.0 V
$I_{CE(lt)}$	Photo Current, Tungsten Source (Note 3)	200	750		200	750		µA	V_{CE} = 5.0 V, H = 5 mW/cm²
$I_{CE(lt)}$	Photo Current, Tungsten Source (Note 3)		1.75			1.75		mA	V_{CE} = 5.0 V, H = 10 mW/cm²
$I_{CE(lt)}$	Photo Current, GaAs Source (Note 4)		2.25			2.25		mA	V_{CE} = 5.0 V, H = 5 mW/cm²
t_r	Light Current Rise Time (Note 6)		4.0			4.0		µs	GaAs, I_C = 2.0 mA,
t_f	Light Current Fall Time (Note 6)		4.0			4.0		µs	R_L = 100Ω, V_{CC} = 5.0 V
S_{min}/S_{max}	Matching Factor (Notes 3 and 5)	0.5	0.65	1.0	0.75	0.85	1.0		V_{CE} = 5.0 V, H = 5 mW/cm²

*Planar is a patented Fairchild process.

TYPICAL CHARACTERISTIC CURVES

PHOTO CURRENT CHARACTERISTICS

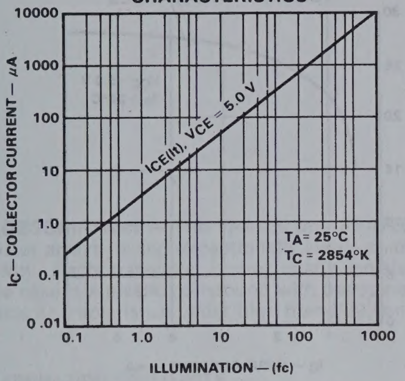
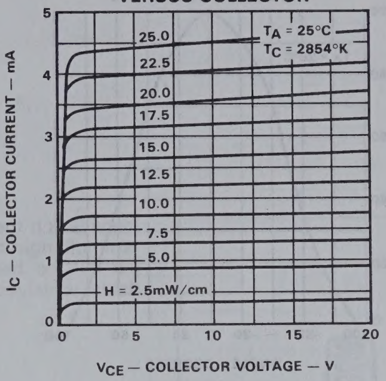
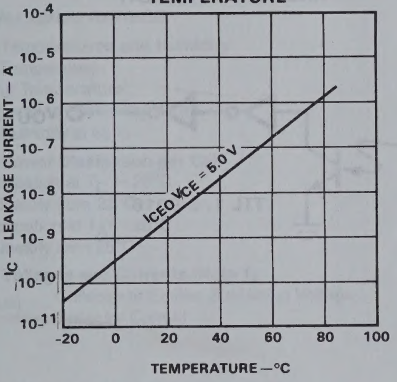


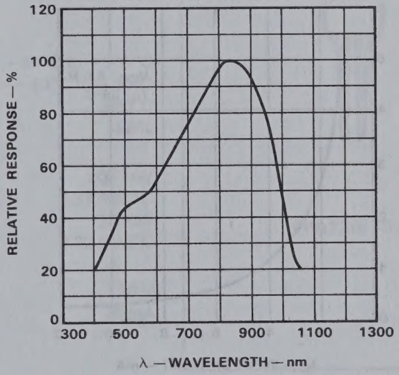
PHOTO CURRENT VERSUS COLLECTOR



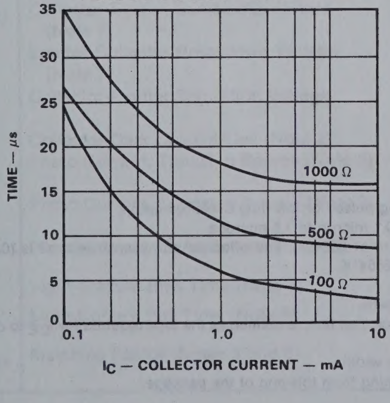
COLLECTOR DARK CURRENT VERSUS TEMPERATURE



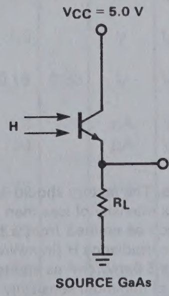
RELATIVE SPECTRAL RESPONSE



RISE AND FALL TIME VERSUS COLLECTOR CURRENT

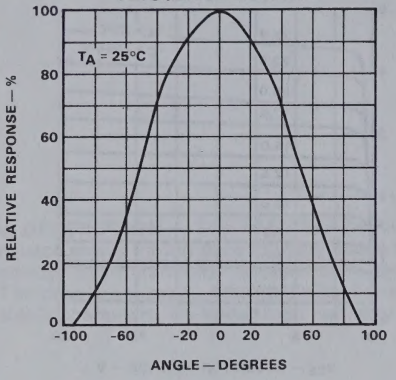


SWITCHING CIRCUIT FOR RISE AND FALL TIMES

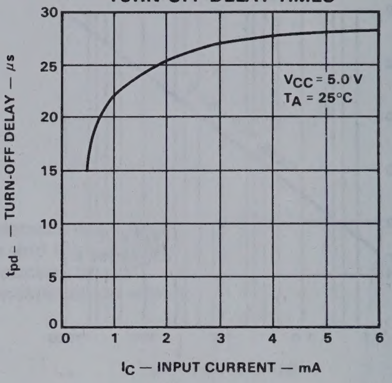


TYPICAL CHARACTERISTIC CURVES (Cont'd)

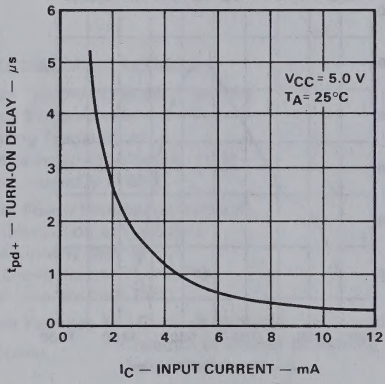
ANGULAR RESPONSE



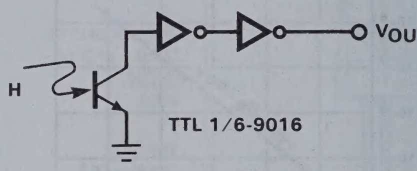
TURN-OFF DELAY TIMES



TURN-ON DELAY TIMES



CIRCUIT FOR TURN-ON AND TURN-OFF DELAY



NOTES:

1. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
2. Measured with radiation flux intensity of less than .1 μW/cm² over the spectrum from 0.1 micron to 1.5 microns.
3. Measured at noted irradiance as emitted from a tungsten lamp at a color temperature of 2854°K. The effective photosensitive area is (0.8 mm²). Illuminance (in lumens/ft²) = irradiance H (in mW/cm²) x 20 at a color temperature of 2854°K.
4. Measured at an irradiance of 5.0 mW/cm² as emitted from a gallium arsenide diode.
5. Matching factor is the ratio of minimum sensitivity to maximum sensitivity of any two cells.
6. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of the peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of the peak value.
7. The center of each element is aligned to ±.010" along the length and ±.005" across the width.
8. Leads alternate from emitter to collector (sensor) or anode to cathode (source), beginning from this end of the package.

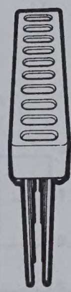
FPA720 • FPA720A

10-ELEMENT PHOTOTRANSISTOR CARD READER ARRAY

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION — The FPA720 and FPA720A are 9-element npn Planar* phototransistor arrays having exceptionally stable characteristics and high illumination sensitivity. Each transistor is electrically isolated and mounted on 100 mil centers. The case is a plastic compound with transparent resin encapsulation which exhibits stable characteristics under high humidity conditions.

- **HIGH ILLUMINATION SENSITIVITY**
- **ESPECIALLY DESIGNED FOR PUNCHED OR MARKED CARD READING AND OPTICAL ENCODER APPLICATIONS**



FPA720/720A

ABSOLUTE MAXIMUM RATINGS

Maximum Temperatures and Humidity

Storage Temperature	−40°C to +100°C
Operating Temperature	−40°C to +85°C
Pin Temperature (Soldering, 10 s)	260°C
Relative Humidity at 65°C	98%

Maximum Power Dissipation per Cell

Total Dissipation at $T_C = 25°C$	200 mW
Derate Linearly from 25°C	3.33 mW/°C
Total Dissipation at $T_A = 25°C$	133 mW
Derate Linearly from 25°C	2.22 mW/°C

Maximum Voltages and Currents (Note 1)

$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage	20 V
I_C	Collector Current	25 mA

ELECTRICAL CHARACTERISTICS: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	FPA720 MIN	FPA720 TYP	FPA720 MAX	FPA720A MIN	FPA720A TYP	FPA720A MAX	UNITS	TEST CONDITIONS
$V_{CEO(sus)}$	Collector-Emitter Sustaining Voltage (Note 7)	20	35		20	35		V	$I_C = 1.0$ mA (pulsed)
BV_{ECO}	Emitter-Collector Breakdown Voltage (Note 7)		7.0			7.0		V	$I_{EC} = 100\ \mu A$
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage		0.16	0.33		0.16	0.33	V	$I_C = 500\ \mu A$, $H = 20\ mW/cm^2$
I_{CEO}	Collector Dark Current/Cell (Note 2)		4.0	100		4.0	100	nA	$V_{CE} = 5.0$ V
$I_{CE(lt)}$	Photo Current, Tungsten Source (Note 3)	200	750		200	750		µA	$V_{CE} = 5.0$ V, $H = 5\ mW/cm^2$
$I_{CE(lt)}$	Photo Current, Tungsten Source (Note 3)		1.75			1.75		mA	$V_{CE} = 5.0$ V, $H = 10\ mW/cm^2$
$I_{CE(lt)}$	Photo Current, GaAs Source (Note 4)		2.25			2.25		mA	$V_{CE} = 5.0$ V, $H = 5\ mW/cm^2$
t_r	Light Current Rise Time (Note 6)		4.0			4.0		µs	GaAs, $I_C = 2.0$ mA,
t_f	Light Current Fall Time (Note 6)		4.0			4.0		µs	$R_L = 100\Omega$, $V_{CC} = 5.0$ V
S_{min}/S_{max}	Matching Factor (Notes 3 and 5)	0.5	0.65	1.0	0.75	0.85	1.0		$V_{CE} = 5.0$ V, $H = 5\ mW/cm^2$

*Planar is a patented Fairchild process.

TYPICAL CHARACTERISTIC CURVES

PHOTO CURRENT CHARACTERISTICS

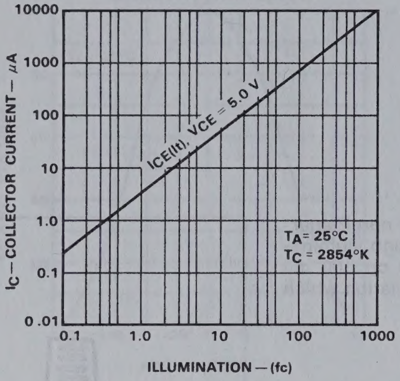
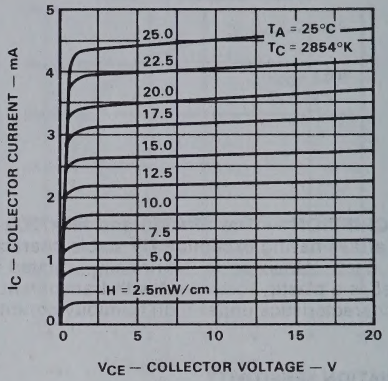
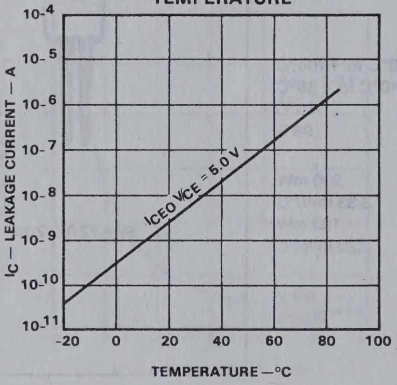


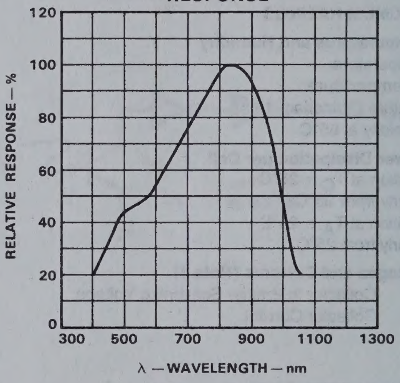
PHOTO CURRENT VERSUS COLLECTOR VOLTAGE



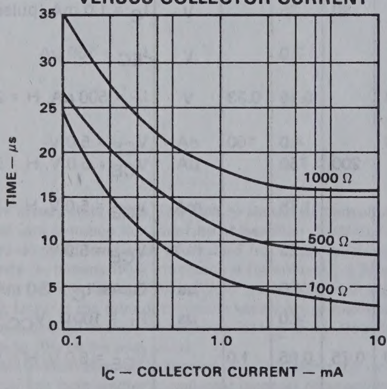
COLLECTOR DARK CURRENT VERSUS TEMPERATURE



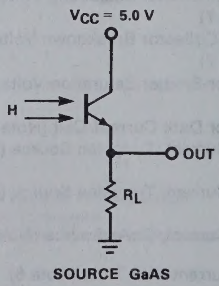
RELATIVE SPECTRAL RESPONSE



RISE AND FALL TIME VERSUS COLLECTOR CURRENT

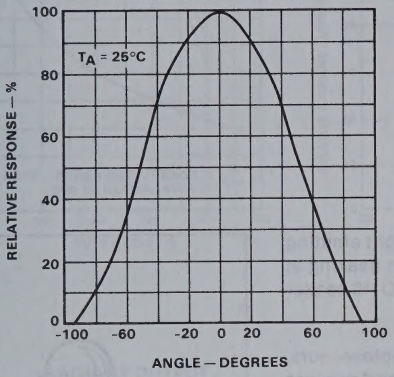


SWITCHING CIRCUIT FOR RISE AND FALL TIMES

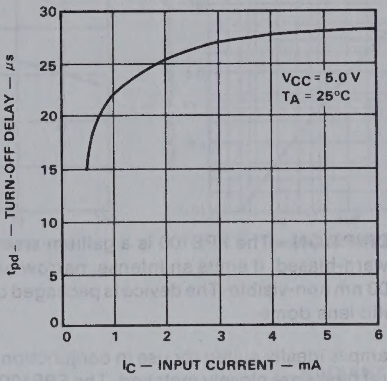


TYPICAL CHARACTERISTIC CURVES (Cont'd)

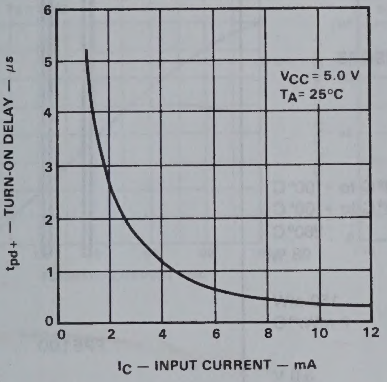
ANGULAR RESPONSE



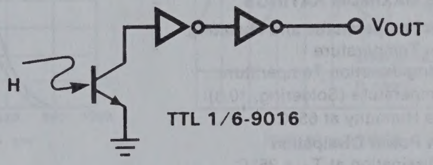
TURN-OFF DELAY TIMES



TURN-ON DELAY TIMES



CIRCUIT FOR TURN-ON AND TURN-OFF DELAY



NOTES:

1. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
2. Measured with radiation flux intensity of less than .1 μW/cm² over the spectrum from 0.1 micron to 1.5 microns.
3. Measured at noted irradiance as emitted from a tungsten lamp at a color temperature of 2854°K. The effective photosensitive area is (0.8 mm²). Illuminance (in lumens/ft²) = irradiance H (in mW/cm²) x 20 at a color temperature of 2854°K.
4. Measured at an irradiance of 5.0 mW/cm² as emitted from a gallium arsenide diode.
5. Matching factor is the ratio of minimum sensitivity to maximum sensitivity of any two cells.
6. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of the peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of the peak value.
7. Rating refers to a high current point where collector to emitter voltage is lowest.
8. The center of each element is aligned to ±.010" along the length and ±.005" across the width.
9. Emitter terminal side of phototransistor (sensor array) or anode terminal side of diode (source array) defined by white dot.

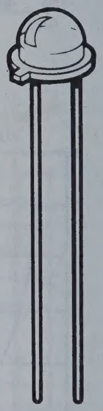
FPE100

GaAs INFRARED EMITTER

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION - The FPE100 is a gallium arsenide infrared light emitting diode. When forward-biased, it emits an intense, narrow band of radiation peaking at approximately 900 nm non-visible. The device is packaged on a modified TO-46 header with a clear plastic lens dome.

This solid state lamp is ideally suited for use in conjunction with silicon photosensors, since their spectral peaks are closely matched. The FPE100 employs a Planar* process and is especially designed for high reliability and long life.



FPE100

- **HIGH RELIABILITY**
- **LONG LIFE**
- **IDEALLY SUITED FOR USE IN CONJUNCTION WITH SILICON PHOTOSENSORS**

ABSOLUTE MAXIMUM RATINGS

Maximum Temperatures and Humidity

Storage Temperature	-10°C to +100°C
Operating Junction Temperature	-10°C to +100°C
Pin Temperature (Soldering, 10 s)	260°C
Relative Humidity at 65°C	98 %

Maximum Power Dissipation

Total Dissipation at T_A = 25°C	150 mW
Derate Linearly from 25°C	2 mW/°C

Maximum Voltages and Currents

V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	100 mA

ELECTRICAL CHARACTERISTICS: T_A = 25°C

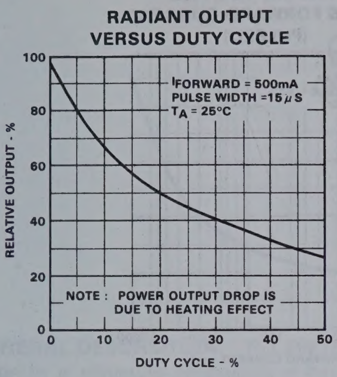
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS
V_F	Forward Voltage At I_F = 100 mA		1.35	1.9	V
B_{VR}	Reverse Breakdown Voltage (I_R = 100 μA)	3.0	6.0		V

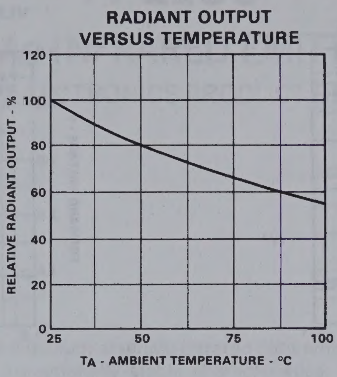
OPTO ELECTRONIC CHARACTERISTICS @ I_F = 100 mA: T_A = 25°C

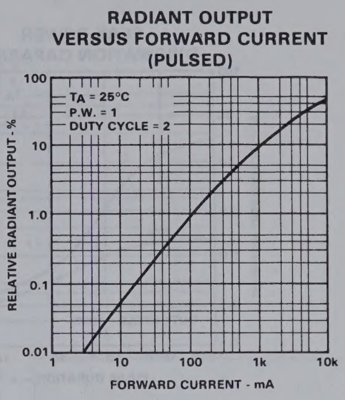
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS
I_O	Axial Intensity	0.1	0.3		mW/sr
P_O	Infrared Total Power Output		1.2		mW
λ	Quantum Efficiency		1.1		%
$\Delta\lambda$	Spectral Bandwidth		50		nm
$\theta_{1/2}$	Beam angle at 50% Axial Intensity		75		degrees
$\Delta P_O/\Delta T$	Temperature Dependence of Power Output		-0.8		%/°C
t_r	Emission Rise Time (I_F = 50 mA 10-90%)		50		ns
t_f	Emission Fall Time (I_F = 50 mA 10-90%)		60		ns

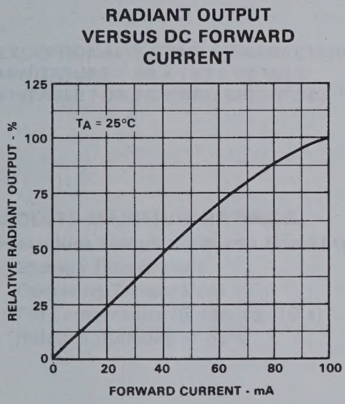
*Planar is a patented Fairchild process.

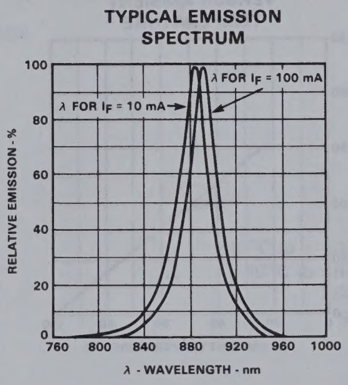
TYPICAL CHARACTERISTIC CURVES

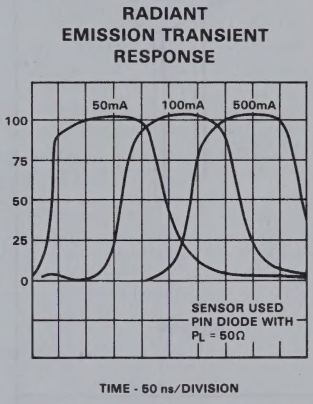

RADIANT OUTPUT VERSUS DUTY CYCLE

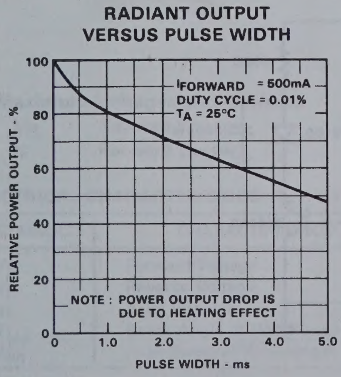

RADIANT OUTPUT VERSUS TEMPERATURE

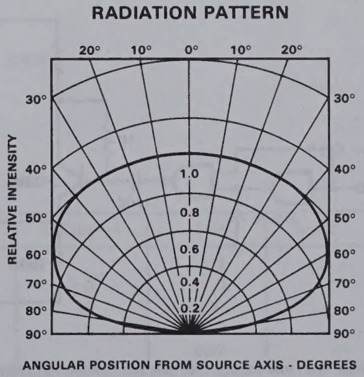

RADIANT OUTPUT VERSUS FORWARD CURRENT (PULSED)

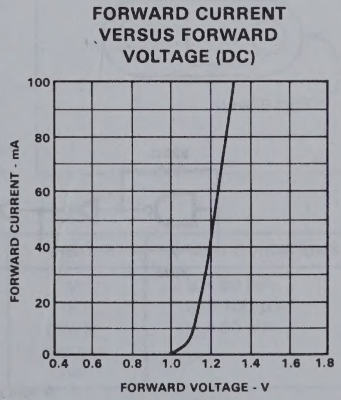

RADIANT OUTPUT VERSUS DC FORWARD CURRENT


TYPICAL EMISSION SPECTRUM


RADIANT EMISSION TRANSIENT RESPONSE

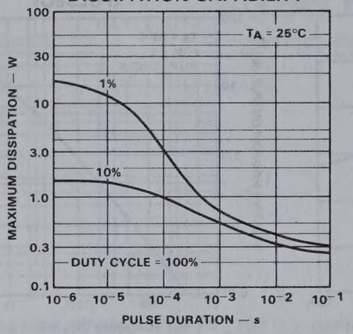

RADIANT OUTPUT VERSUS PULSE WIDTH


RADIATION PATTERN

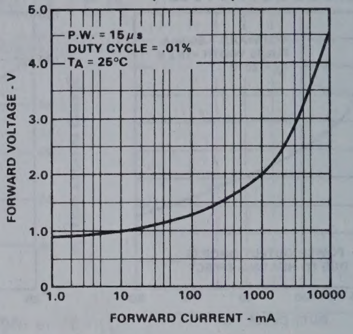

FORWARD CURRENT VERSUS FORWARD VOLTAGE (DC)

TYPICAL CHARACTERISTIC CURVES (Cont'd)

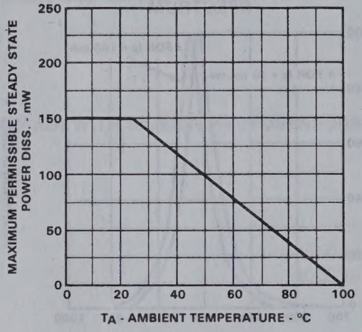
PEAK POWER DISSIPATION CAPABILITY



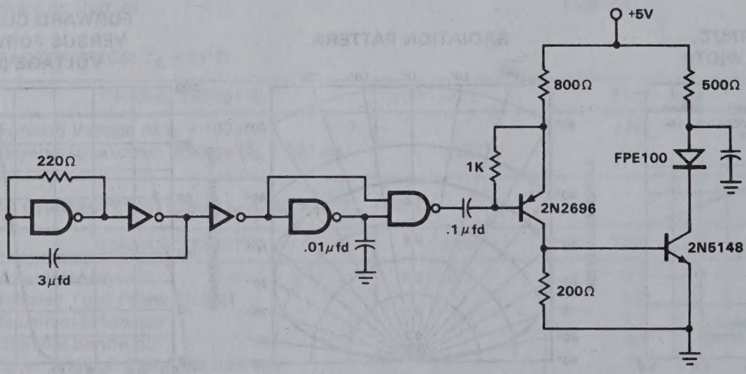
FORWARD VOLTAGE VERSUS FORWARD CURRENT (PULSED)



POWER DISSIPATION VERSUS AMBIENT TEMPERATURE



2 AMP LIGHT PULSER



+5V
800Ω
500Ω
FPE100
200μfd
1K
220Ω
2N2696
.1μfd
.01μfd
3μfd
2N5148
200Ω

A light pulser with low voltage low average current requirement
Peak current through 2 A
Pulse with = 5 μs
Period between pulses 20 ms
Average current drain 20 mA

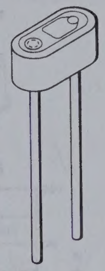
FPE106

GaAs INFRARED EMITTER

OPTOELECTRONICS PRODUCT GROUP

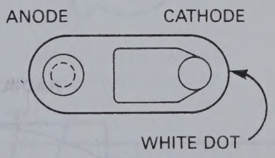
GENERAL DESCRIPTION – The FPE106 is a gallium arsenide infrared light emitting diode in a miniature ceramic case having exceptionally stable characteristics. This device is used in applications where space is limited such as custom tape and card readers.

- **EXCEPTIONALLY STABLE CHARACTERISTICS**
- **MINITATURE – 85 x 185 x 95 MILS**
- **SUITABLE FOR PC CARD MOUNTING**



FPE106

PIN CONNECTIONS



ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	−40°C to + 100°C
Operating Temperature	−40°C to +85°C
Pin Temperature (Soldering, 10 s)	260°C
Relative Humidity at 65°C	98%

Maximum Power Dissipation

Total Dissipation at $T_A = 25°C$	150 mW
Derate Linearly from 25°C	2.5 mW/°C

Maximum Voltages and Currents

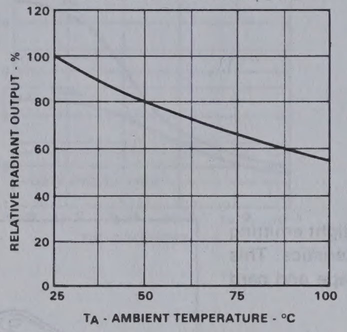
V_R	Reverse Voltage	3.0 V
I_F	Forward Current	100 mA

ELECTRICAL CHARACTERISTICS: $T_A = 25°C$

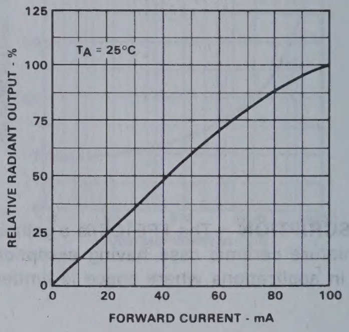
SYMBOL	CHARACTERISTICS	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.3	1.5	V	$I_F = 50$ mA
V_R	Reverse Voltage	3.0	6.0		V	$I_R = 100\ \mu$A
I_O	Axial Intensity	35	200		µW/sr	$I_F = 50$ mA
$\theta_{1/2}$	Beam Angle at Half Power	3.5	80		degrees	
λ_{pk}	Peak Spectral Wavelength		890		nm	

TYPICAL CHARACTERISTIC CURVES

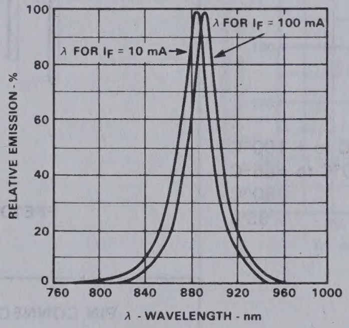
RADIANT OUTPUT VERSUS TEMPERATURE



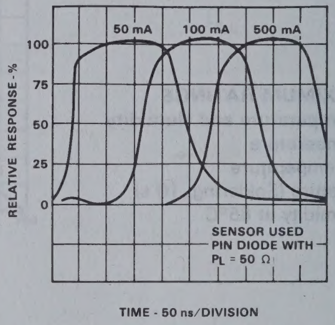
RADIANT OUTPUT VERSUS DC FORWARD CURRENT



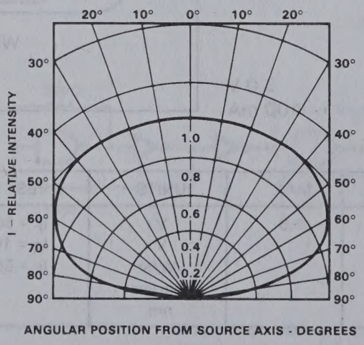
EMISSION SPECTRUM



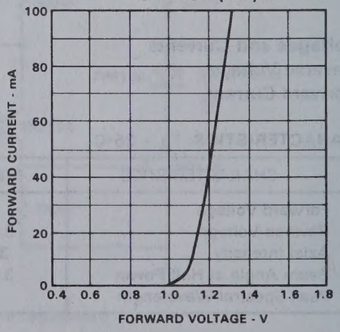
RADIANT EMISSION TRANSIENT RESPONSE



RADIATION PATTERN



FORWARD CURRENT VERSUS FORWARD VOLTAGE (DC)



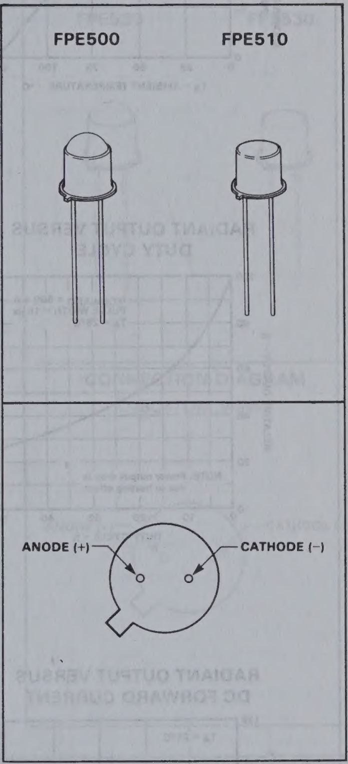
FPE500 • FPE510

GaAs INFRARED EMITTERS

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The FPE500/FPE510 are gallium arsenide infrared emitting diodes. When forward-biased, they emit an intense, narrow band of radiation peaking at approximately 900 nm (non-visible). The devices are packaged in TO-18 style hermetically sealed packages with a glass lens.

These solid state lamps are ideally suited for use in conjunction with silicon photosensors, since their spectral peaks are closely matched. The FPE500/FPE510 use a Planar* process and are especially designed for high reliability and long life.



- **HIGH RELIABILITY**
- **LONG LIFE**
- **IDEALLY SUITED FOR USE IN CONJUNCTION WITH SILICON PHOTOSENSORS**
- **APPLICATIONS INCLUDE: PUNCHED CARD AND PAPER TAPE READING, OPTICAL SHAFT ENCODERS, CHOPPERS, HIGH-SPEED HIGH VOLTAGE ISOLATION SWITCHES AND HIGH SPEED OPTO-ELECTRONIC SIGNAL LINKS**
- **HERMETIC METAL PACKAGE FOR STABILITY AND RELIABILITY**

ABSOLUTE MAXIMUM RATINGS

Maximum Temperatures and Humidity

Storage Temperature	−65°C to +200°C
Operating Temperature	−65°C to +125°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	85%

Maximum Power Distribution

P_D	Power Dissipation	250 mW
	Derate Linearly from 25°C	2.5 mW/°C

Maximum Voltages and Currents

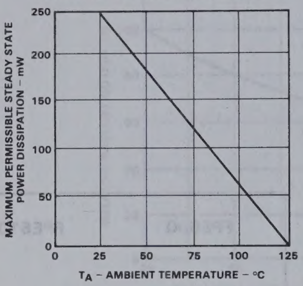
V_R	Reverse Voltage	3.0 V
I_F	Forward Current	150 mA

ELECTRICAL CHARACTERISTICS: $T_A = 25°C$, $I_F = 100$ mA

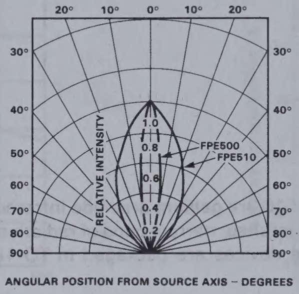
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.35	1.7	V	
BV_R	Reverse Breakdown Voltage	3.0	6.0		V	$I_R = 100\ \mu A$
I_O	Axial Intensity					
	FPE500	3.0	10		mW/Sr	
	FPE510	0.3	1.0		mW/Sr	
P_O	Infrared Total Power Output		1.2		mW	
$\Delta P_O/\Delta T$	Temperature Dependence of Power Output		−0.8		%/°C	
BW	Spectral Bandwidth		50		nm	
$\theta_{1/2}$	Viewing Angle to Half Intensity					
	FPE500		9.0		degrees	
	FPE510		30		degrees	
t_r, t_f	Emission Rise and Fall Time		10		ns	$I_F = 50$ mA, 10-90%

TYPICAL CHARACTERISTIC CURVES

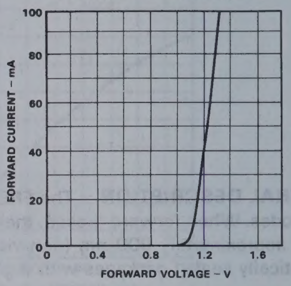
POWER DISSIPATION VERSUS AMBIENT TEMPERATURE



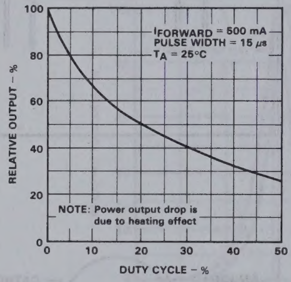
RADIATION PATTERN



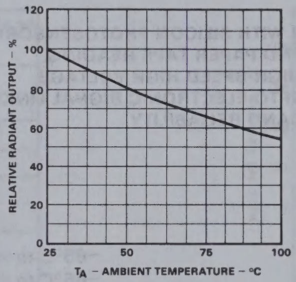
FORWARD CURRENT VERSUS FORWARD VOLTAGE (DC)



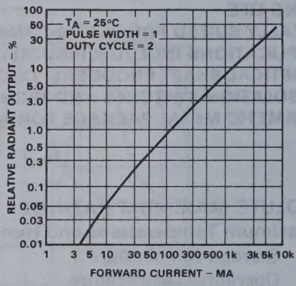
RADIANT OUTPUT VERSUS DUTY CYCLE



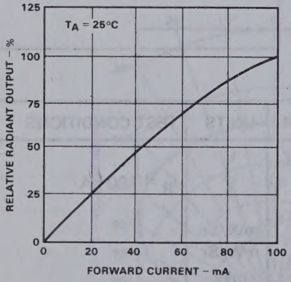
RADIANT OUTPUT VERSUS TEMPERATURE



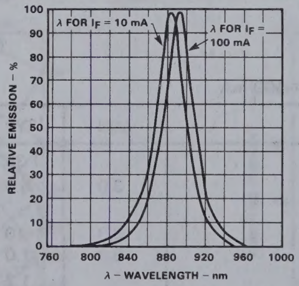
RADIANT OUTPUT VERSUS FORWARD CURRENT (PULSED)



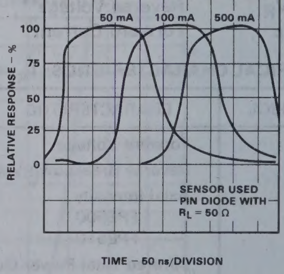
RADIANT OUTPUT VERSUS DC FORWARD CURRENT



TYPICAL EMISSION SPECTRUM



RADIANT EMISSTION TRANSIENT RESPONSE



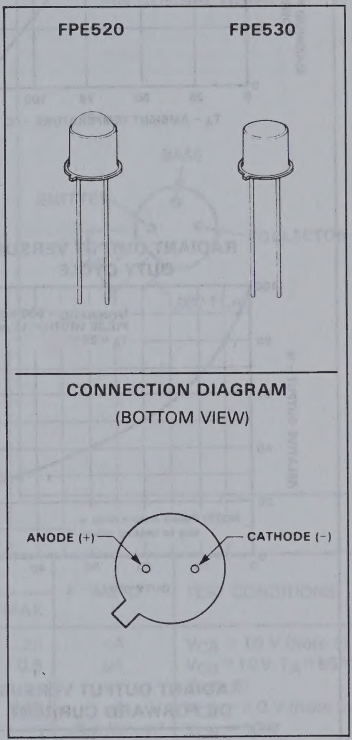
FPE520 • FPE530

GaAs INFRARED EMITTERS

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The FPE520 and FPE530 are gallium arsenide infrared emitting diodes. When forward-biased, they emit an intense, narrow band of radiation peaking at approximately 940 nm (non-visible). The devices are packaged in TO-18 style hermetically sealed packages with a glass lens.

These solid state lamps are ideally suited for use in conjunction with silicon photosensors, since their spectral peaks are closely matched.



CONNECTION DIAGRAM
(BOTTOM VIEW)

- **HIGH RELIABILITY**
- **LONG LIFE**
- **IDEALLY SUITED FOR USE IN CONJUNCTION WITH SILICON PHOTOSENSORS**
- **APPLICATIONS: PUNCHED CARD AND PAPER TAPE READING, OPTICAL SHAFT ENCODERS, CHOPPERS, HIGH-SPEED HIGH VOLTAGE ISOLATION SWITCHES AND HIGH-SPEED OPTOELECTRONIC SIGNAL LINKS**
- **HERMETIC METAL PACKAGE FOR STABILITY AND RELIABILITY**

ABSOLUTE MAXIMUM RATINGS

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Temperature	−65°C to +150°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

Maximum Power Dissipation

Total Dissipation at $T_A = 25°C$	250 mW
Derate Linearly from 25°C	2.0 mW/°C

Maximum Voltages and Currents

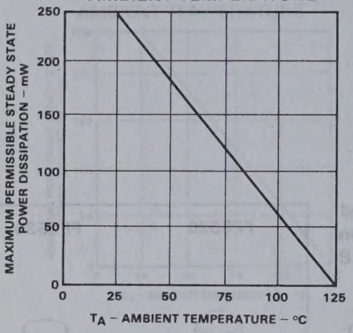
V_R	Reverse Voltage	3.0 V
I_F	Forward Current	150 mA

ELECTRICAL CHARACTERISTICS: $T_A = 25°C$, $I_F = 100$ mA, unless specified

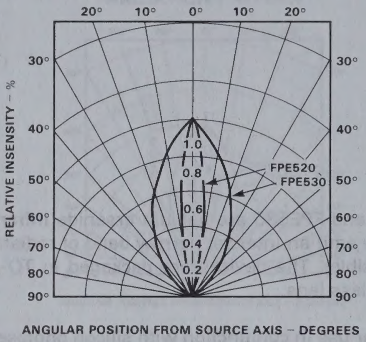
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.35	1.7	V	
V_R	Reverse Voltage	3.0	6.0		V	$I_R = 100\ \mu A$
I_O	Axial Intensity					
	FPE520	10	50		mW/sr	
	FPE530	1.0	5.0		mW/sr	
P_O	Infrared Total Power Output		5.0		mW	
$\Delta P_O/\Delta T$	Temperature Dependence of Power Output		−0.8		%/°C	
λpk	Peak Spectral Wavelength		940		nm	
BW	Spectral Bandwidth		50		nm	
$\theta_{1/2}$	Viewing Angle to Half Intensity					
	FPE520		9.0		degrees	
	FPE530		30		degrees	
t_r, t_f	Emission Rise and Fall Time		500		ns	$I_F = 50$ mA, 10–90%

TYPICAL CHARACTERISTIC CURVES

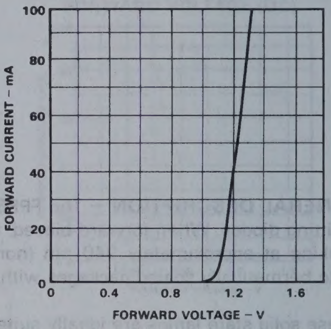
POWER DISSIPATION VERSUS AMBIENT TEMPERATURE



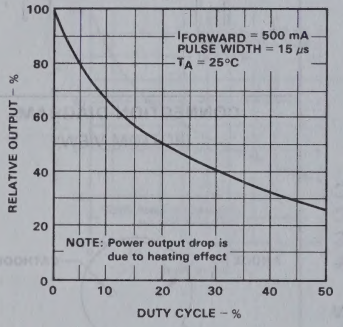
RADIATION PATTERN



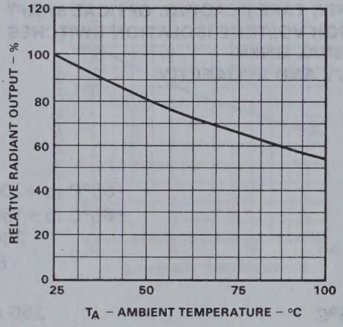
FORWARD CURRENT VERSUS FORWARD VOLTAGE (DC)



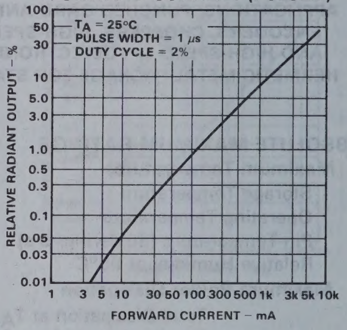
RADIANT OUTPUT VERSUS DUTY CYCLE



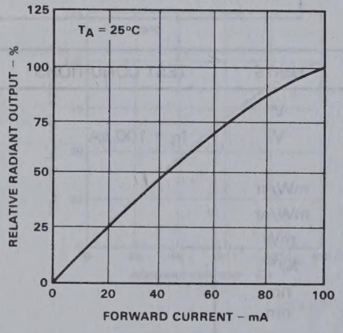
RADIANT OUTPUT VERSUS TEMPERATURE



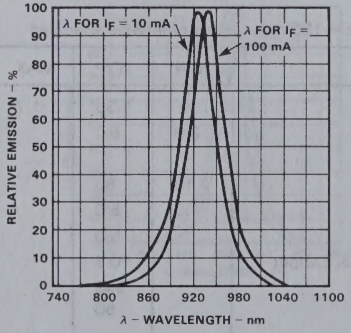
RADIANT OUTPUT VERSUS FORWARD CURRENT (PULSED)



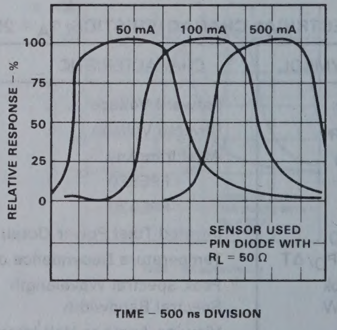
RADIANT OUTPUT VERSUS DC FORWARD CURRENT



EMISSION SPECTRUM



RADIANT EMISSION TRANSIENT RESPONSE



FPT100/A/B • FPT110/A/B

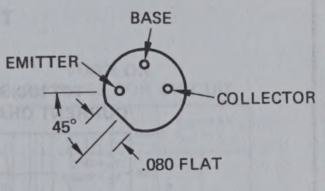
GENERAL PURPOSE SILICON PLANAR* PHOTOTRANSISTOR

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION — The FPT100 and FPT110 are 3-terminal npn Planar* phototransistors which have exceptionally stable characteristics and high illumination sensitivity. The availability of the base pin gives wide latitude for flexible circuit design. The case is a special plastic compound with transparent resin encapsulation which exhibits stable characteristics under high humidity conditions. The controlled sensitivities offered in the A and B versions gives the circuit designer increased flexibility.

- **EXCEPTIONALLY STABLE CHARACTERISTICS**
- **CONTROLLED SENSITIVITIES**

PIN CONNECTIONS



ABSOLUTE MAXIMUM RATINGS

Maximum Temperatures/Humidity	
Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	98%
Maximum Power Dissipation (Notes 1 and 2)	
Total Dissipation at T_C = 25°C	200 mW
Total Dissipation at T_A = 25°C	100 mW
Maximum Voltages and Current (Note 5)	
V_{CBO} Collector to Base Voltage	50 V
V_{CEO} Collector to Emitter Sustaining Voltage (Note 3)	30 V
I_C Collector Current	25 mA

ELECTRICAL CHARACTERISTICS: T_A = 25°C

SYMBOL	CHARACTERISTIC	FPT100/A/B			FPT110/A/B			UNITS	TEST CONDITIONS
		MIN	TYP	MAX	MIN	TYP	MAX		
I_{CBO}	Collector Dark Current		0.25	25		0.25	25	nA	V_{CB} = 10 V (Note 5)
I_{CBO}	Collector Dark Current		0.025	0.5		0.025	0.5	μA	V_{CB} = 10 V, T_A = 65°C (Note 5)
I_{CEO}	Collector Dark Current		2.0	100		2.0	100	nA	V_{CE} = 5.0 V (Note 5)
R_{CB}	Responsivity (Tungsten)	0.6	1.6		0.6	1.0		μA/mW/cm²	V_{CB} = 10 V (Notes 3 and 8)
R_{CB}	Responsivity (GaAs)	1.8	4.8		1.8	3.0		μA/mW/cm²	V_{CB} = 10 V (Notes 4 and 8)
$I_{CE(lt)}$	Photo Current (Tungsten)	0.2	1.4		0.2	.88		mA	V_{CE} = 5.0 V H = 5.0 mW/cm² (Notes 3 and 7)
$I_{CE(lt)}$	Photo Current (GaAs)	0.6	4.2		0.6	2.7		mA	V_{CE} = 5.0 V H = 5.0 mW/cm² (Notes 4 and 7)
t_r	Light Current Rise Time		2.8			2.8		μs	(Note 6)
t_f	Light Current Fall Time		2.8			2.8		μs	(Note 6)
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage		0.16	0.3		0.16	0.33	V	I_C = 500 μA H = 20 mW/cm²
BV_{CBO}	Collector to Base Breakdown Voltage	50	120		50	120		V	I_C = 100 μA (Note 5)
$V_{CEO(sus)}$	Collector to Emitter Sustaining Voltage	30	50		30	50		V	I_C = 1.0 mA (pulsed) (Note 5)
BV_{ECO}	Emitter to Collector Breakdown		7.0			7.0		V	I_E = 100 μA (Note 5)

*Planar is a patented Fairchild process.

ELECTRICAL CHARACTERISTICS: T_A = 25°C unless otherwise noted (Cont'd)
The following values affect the A and B versions only:

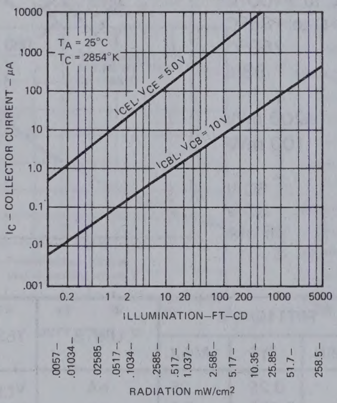
SYMBOL	CHARACTERISTIC	MIN	MAX	MIN	MAX	UNITS	TEST CONDITIONS
$I_{CE(lt)}$*	Photo Current (Tungsten Source)						
	FPT100A	1.0	3.0			mA	V_{CE} = 5.0 V (Note 3)
	FPT110A			0.6	1.8	mA	H = 5.0 mW/cm²
$I_{CE(lt)}$	Photo Current (Tungsten Source)						
	FPT100B	1.3	2.6			mA	V_{CE} = 5.0 V (Note 3)
	FPT110B			0.8	1.6	mA	H = 5.0 mW/cm²

NOTES:

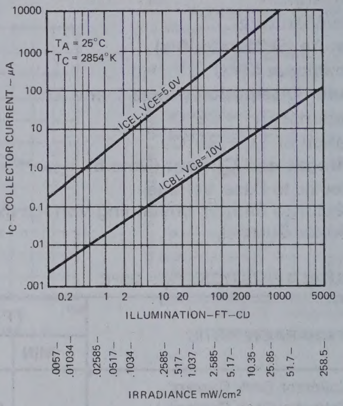
1. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
2. These ratings give a maximum junction temperature of 85°C and junction to case thermal resistance of 300°C/W (derating factor of 3.33 mW/°C), and a junction to ambient thermal resistance of 600°C/W (derating factor of 1.67 mW/°C).
3. Measured at noted irradiance as emitted from a tungsten filament lamp at a color temperature of 2854°K. The effective photosensitive area is typically 1.25 mm² (FPT100A/B) and 0.78 mm² (FPT110A/B).
4. These are values obtained at noted irradiance as emitted from a GaAs source at 900 nm.
5. Measured with radiation flux intensity of less than .1 μW/cm² over the spectrum from 100 to 1500 nm.
6. Rise time is defined as the time required for I_{CE} to rise from 10% of peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of peak value. Test conditions are: I_{CE} = 4.0 mA, V_{CE} = 5.0 V, R_L = 100 Ω, GaAs Source.
7. No electrical connection to base lead.
8. No electrical connection to emitter lead.

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

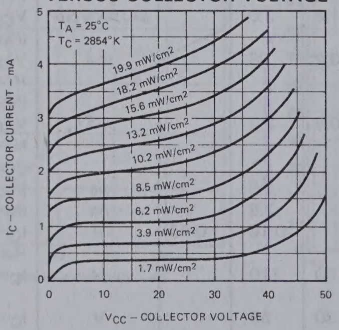
FPT100/A/B PHOTO CURRENT CHARACTERISTICS



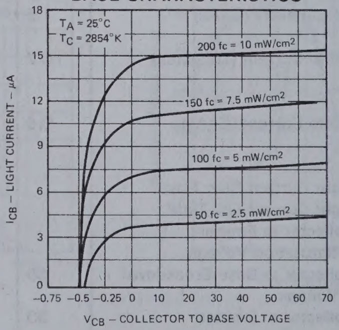
FPT110/A/B PHOTO CURRENT CHARACTERISTICS



COLLECTOR CURRENT VERSUS COLLECTOR VOLTAGE

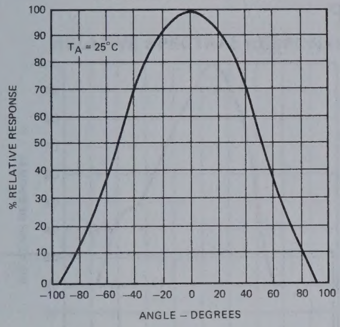


COLLECTOR BASE CHARACTERISTICS

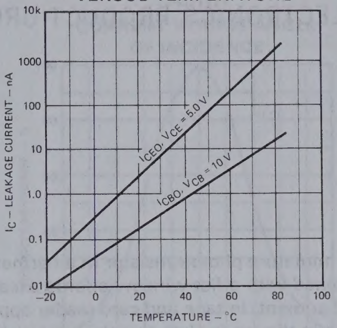


TYPICAL ELECTRICAL CHARACTERISTIC CURVES (Cont'd)

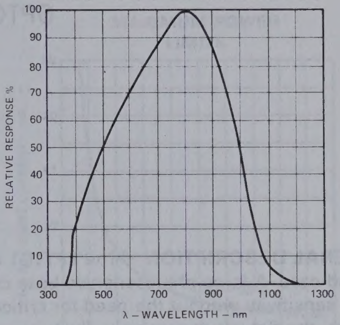
ANGULAR RESPONSE



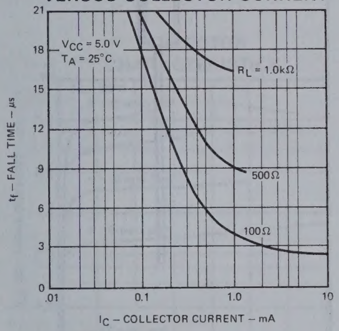
COLLECTOR DARK CURRENT VERSUS TEMPERATURE



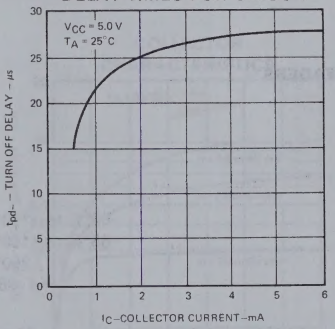
SPECTRAL CHARACTERISTICS



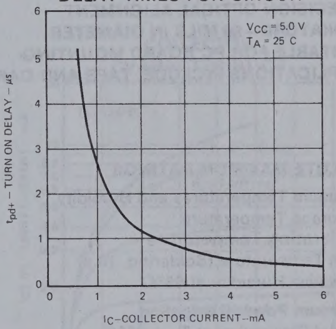
RISE AND FALL TIME VERSUS COLLECTOR CURRENT



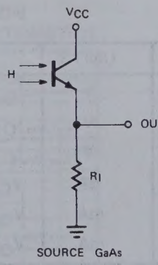
TURN OFF DELAY TIMES FOR CIRCUIT



TURN ON DELAY TIMES FOR CIRCUIT

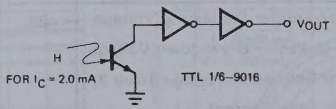


SWITCHING CIRCUIT FOR RISE AND FALL TIMES



V_{CC}
H
OUT
R_l
SOURCE GaAs

CIRCUIT FOR TURN ON AND TURN OFF DATA



V_{OUT}
H
FOR $I_C = 2.0$ mA
TTL 1/6–9016

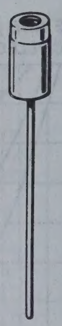
FPT101

HERMETIC COAXIAL SILICON PHOTOTRANSISTOR

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The FPT101 is a miniature phototransistor in a hermetic welded case. A large photosensitive base combined with a flat window affords exceptional sensitivity without the need for critical alignment. In tape and card reader applications, the flat window permits flush mounting in the wear-plate thereby minimizing cross-talk. The spectral response, extending from 400 to 1100 nm, is compatible with daylight, tungsten and gallium arsenide sources.

- **PRECISION OPTICAL ALIGNMENT**
- **MINIATURE—80 MILS IN DIAMETER**
- **SUITABLE FOR PC BOARD MOUNTING**
- **APPLICATIONS INCLUDE: TAPE AND CARD READERS**



FPT 101

ABSOLUTE MAXIMUM RATINGS

Maximum Temperatures and Humidity

Storage Temperature	-65°C to +150°C
Operating Temperature	-65°C to +150°C
Pin Temperature (Soldering, 10 s)	260°C
Relative Humidity at 65°C	98 %

Maximum Power Dissipation

Total Dissipation at T_C = 25°C	75 mW
Derate Linearly from 25°C	0.6 mW/°C

Maximum Voltages and Currents (Note 1)

V_{CEO}	Collector to Emitter Sustaining Voltage	30 V
V_{ECO}	Emitter to Collector Sustaining Voltage	5 V
I_C	Collector Current	25 mA

ELECTRICAL CHARACTERISTICS: T_A = 25°C

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
$V_{CEO(sus)}$	Collector-Emitter Sustaining Voltage	30	60		V	I_C = 0.1 mA, H < 0.1 μW/cm²
BV_{ECO}	Emitter-Collector Breakdown Voltage		7.0		V	I_C = 0.1 mA, H < 0.1 μW/cm²
$V_{CE(sat)}$	Collector Saturation Voltage (Note 2)		0.25	0.3	V	I_C = 0.4 mA, H = 20 mW/cm²
I_{CEO}	Collector Dark Current		2.0	100	nA	V_{CE} = 5.0 V, H < 0.1 μW/cm²
$I_{CE(lt)}$	Collector Photo Current (Notes 2 & 4)	0.8	3.5		mA	V_{CE} = 5.0 V, H = 20 mW/cm²
$I_{CE(lt)}$	Collector Photo Current (Notes 2 & 4)		0.8		mA	V_{CE} = 5.0 V, H = 5.0 mW/cm²

NOTES:

1. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
2. Irradiation source is an unfiltered tungsten lamp operated at 2854°K color temperature. Unless otherwise stated, all H values refer to this color temperature.
3. Switching time is defined here as the 10% to 90% rise time of I_{CE} for an irradiance step input. The rise and fall times are essentially equal.
4. Silicon radiometric photocurrent efficiency with typical GaAs irradiance is approximately three times greater than with tungsten at 2854°K color temperature. Therefore, all graphs with H as a parameter or variable will apply for GaAs irradiation if the H values are divided by three.
5. Emitter is connected to the case.

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

RELATIVE SPECTRAL RESPONSE

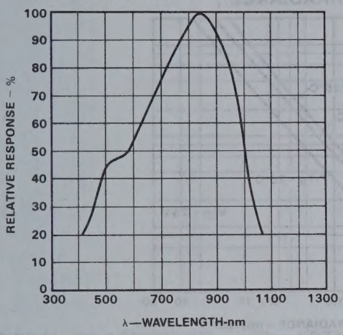
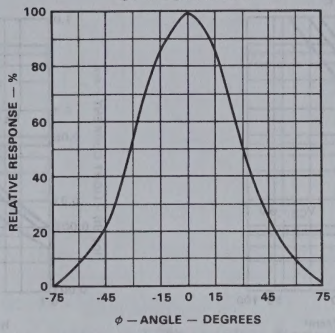
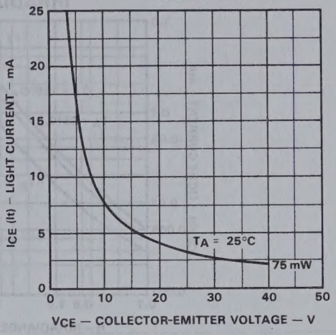


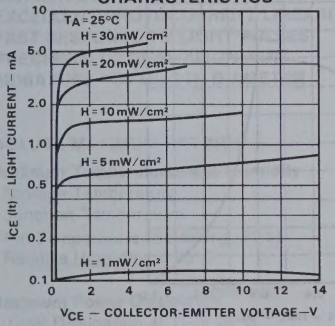
PHOTO CURRENT VERSUS ANGLE OF INCIDENCE



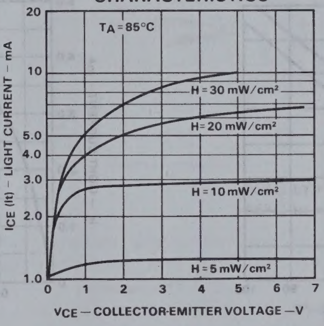
MAXIMUM POWER LIMITS



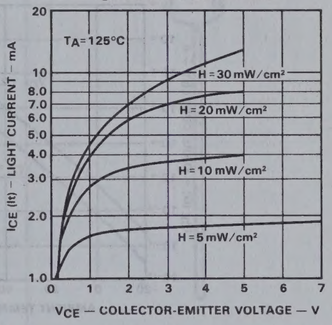
COLLECTOR CHARACTERISTICS



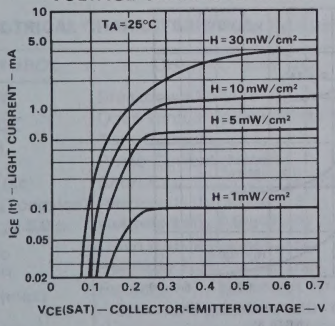
COLLECTOR CHARACTERISTICS



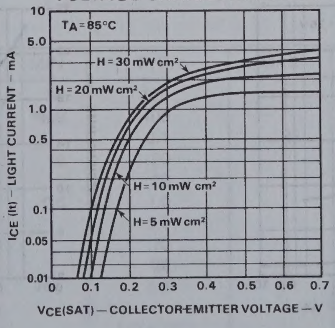
COLLECTOR CHARACTERISTICS



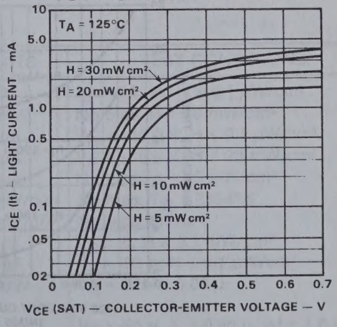
SATURATION VOLTAGE CHARACTERISTICS



SATURATION VOLTAGE CHARACTERISTICS

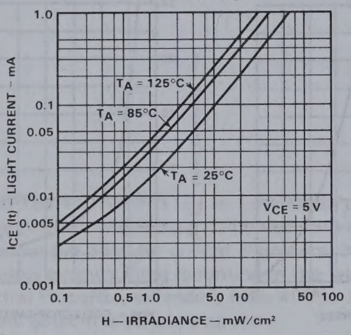


SATURATION VOLTAGE CHARACTERISTICS

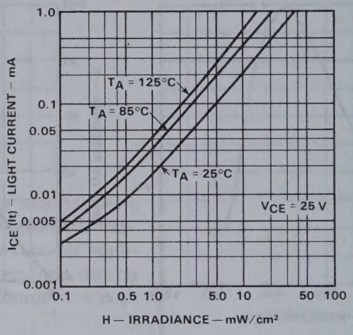


TYPICAL ELECTRICAL CHARACTERISTIC CURVES (Cont'd)

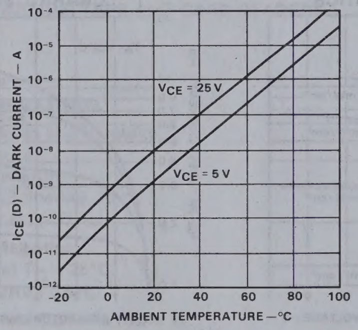
LIGHT CURRENT VERSUS IRRADIANCE



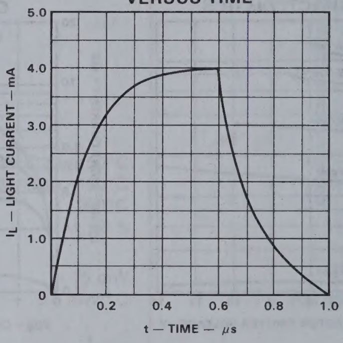
LIGHT CURRENT VERSUS IRRADIANCE



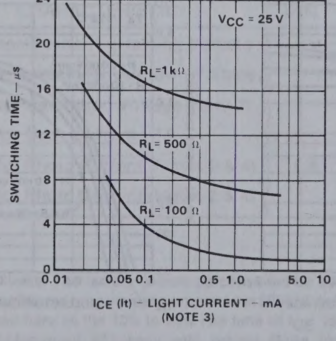
DARK CURRENT CHARACTERISTICS



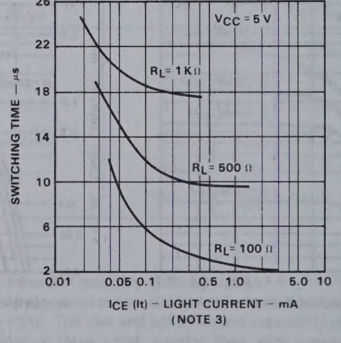
LIGHT CURRENT VERSUS TIME



SWITCHING TIME VERSUS LIGHT CURRENT



SWITCHING TIME VERSUS LIGHT CURRENT



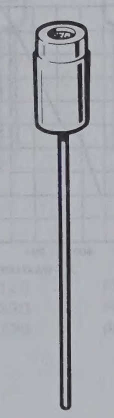
FPT102

HERMETIC COAXIAL SILICON PHOTODIODE

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION — The FPT102 is a miniature light-sensing diode in a hermetic, welded case. In the reverse-bias mode of operation, excellent photocurrent linearity is obtained. In the photovoltaic mode, the open-circuit voltage varies in a logarithmic manner being most sensitive to low-level light variations.

- **SENSITIVE AT LOW LEVEL LIGHT APPLICATIONS**
- **EXCELLENT PHOTOCURRENT LINEARITY**
- **FAST RESPONSE TO LIGHT PULSES**
- **PRECISION OPTICAL ALIGNMENT**
- **MINIATURE—80 MILS IN DIAMETER**



FPT102

ABSOLUTE MAXIMUM RATINGS

Maximum Temperatures and Humidity

Storage Temperature	-55°C to +150°C
Junction Temperature	-55°C to +100°C
Pin Temperature (Soldering, 10 s)	260°C
Relative Humidity at 65°C	98 %

Maximum Power Dissipation

Total Dissipation at T_C = 25°C	75 mW
Derate Linearly from T_C = 25°C	0.6 mW/°C

Maximum Voltages

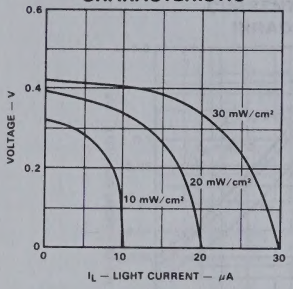
V_R	Reverse Voltage	50 V

ELECTRICAL CHARACTERISTICS: T_A = 25°C

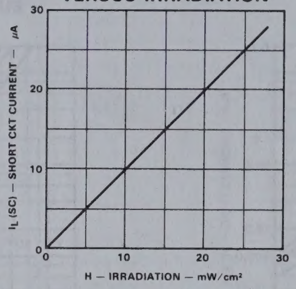
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
BV	Breakdown Voltage	50	120		V	I_R = 5.0 μA, H ⩽ 0.1 μW/cm²
V_{OC}	Open Circuit Voltage (Note 1)	380	400		mV	No bias, H = 20 mW/cm²
I_R	Dark Current		0.1	25	nA	V_R = -10.0 V, H ⩽ 0.1 μW/cm²
I_L	Photo Current (Note 1)	12	20		μA	V_R = -10.0 V, H = 20 mW/cm²
I_L(sc)	Short Circuit Current (Note 1)	12	20		μA	No bias, H = 20 mW/cm²
R(Tungsten)	Responsivity (Notes 1 & 2)	0.6	1.0		μA/mW/cm²	No bias, T_C = 2854°K
R @ 0.9 μ	Responsivity 0.9 μ (Note 2)		3.0		μA/mW/cm²	No bias, GaAs
C_o	Open Circuit Capacitance		70		pF	V_R = 0, H ⩽ 0.1 mW/cm²
C_R	Reversed Bias Capacitance		20		pF	V_R = -10 V, H ⩽ 0.1 μW/cm²
$R_{(max)}$	Responsivity (absolute) at Spectral Peak (Note 2)		0.6		A/W	V_R = 0, λ = 0.80 μ
NEP	Noise Equivalent Power (Note 2)		1.0×10^{-14}		W	V_R = -10 V, λ = 0.80 μ, Δf = 1.0 Hz
D	Detectivity (Note 2)		8.8×10^{12}		$\frac{cm\sqrt{Hz}}{W}$	V_R = 10 V, λ = 0.80 μ, f = 1.0 kHz, Δf = 1.0 Hz

TYPICAL ELECTRICAL CHARACTERISTICS

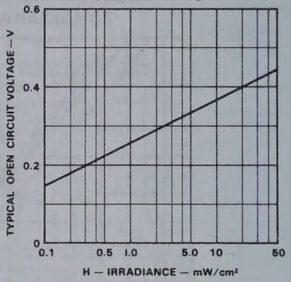
TYPICAL VOLTAGE VERSUS CURRENT CHARACTERISTIC



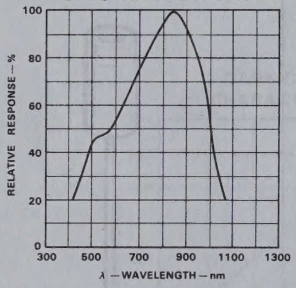
TYPICAL SHORT CIRCUIT CURRENT VERSUS IRRADIATION



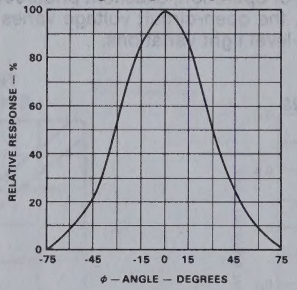
TYPICAL OPEN CIRCUIT VOLTAGE VERSUS IRRADIATION



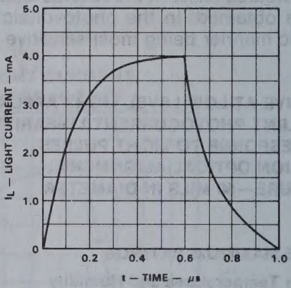
RELATIVE SPECTRAL RESPONSE



TYPICAL PHOTO CURRENT VERSUS ANGLE OF INCIDENCE



TYPICAL LIGHT CURRENT VERSUS TIME



NOTES:

1. Irradiation source is an unfiltered tungsten lamp operated at 2854°K color temperature.
2. Sensitive Area = 7.75 x 10^{-3} cm². (Response at metalization is negligible.)

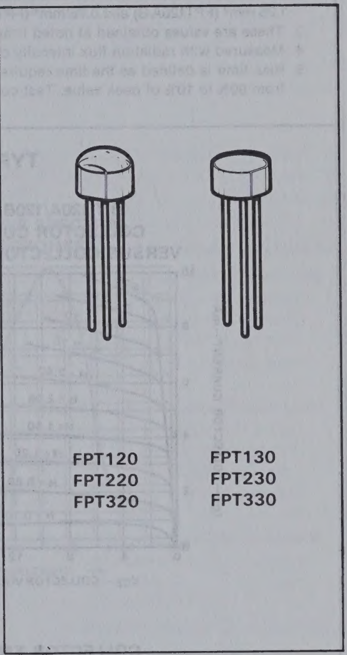
FPT120/220/320 • FPT130/230/330

HIGH SENSITIVITY SILICON PHOTOTRANSISORS

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION — The FPT120/220/320 FPT130/230/330 are silicon nitride protected npn Planar* phototransistors having exceptionally stable characteristics and high illumination sensitivity. The case is made of a special plastic compound with transparent resin encapsulation. The controlled sensitivities offered in the 230, 330, 220 and 320 versions gives the circuit designer increased flexibility.

- **HIGH ILLUMINATION SENSITIVITY**
- **AVAILABILITY OF BASE-PINS FOR FLEXIBLE CIRCUIT DESIGN**



ABSOLUTE MAXIMUM RATINGS

Maximum Temperatures/Humidity

Storage Temperature	−55° C to +100° C
Operating Temperature	−55° C to +85° C
Pin Temperature (Soldering, 10 s)	260° C
Relative Humidity at 65° C	98 %

Maximum Power Dissipation (Note 1)

Total Dissipation at T_C = 25° C	200 mW
Derate Linearly from T_C = 25° C	3.33 mW/° C
Total Dissipation at T_A =25° C	100 mW
Derate Linearly from T_A = 25° C	1.67 mW/° C

Maximum Voltage and Currents

V_{CEO}	Collector to Emitter Sustaining Voltage (Note 4)	20 V
I_C	Collector Current	25 mA

ELECTRICAL CHARACTERISTICS: T_A = 25° C

SYMBOL	CHARACTERISTIC	FPT/120/220/320			FPT/130/230/330			UNITS	TEST CONDITIONS
		MIN	TYP	MAX	MIN	TYP	MAX		
$V_{CEO(sus)}$	Collector-Emitter Sustaining Voltage (Note 4)	20	50		20	50		V	I_C = 1 mA (Pulsed)
BV_{ECO}	Emitter-Collector Breakdown Voltage (Note 4)		5.0			5.0		V	I_{EC} = 100 μA
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage, Tungsten Source (Note 2)		0.25	0.55		0.25	0.55	V	I_C = 1 mA H = 20 mW/cm²
I_{CEO}	Collector Dark Current (Note 4)		10	100		10	100	nA	V_{CE} = 5.0 V
$I_{CE(lt)}$	Photo Current, Tungsten Source (Note 2)	0.4	1.5		0.4	0.9		mA	V_{CE} = 5.0 V H=1 mW/cm²
$I_{CE(lt)}$	Photo Current, Tungsten Source (Note 2)		7.5			4.5		mA	V_{CE} = 5.0 V H=5 mW/cm²
$I_{CE(lt)}$	Photo Current, GaAs Source (Note 3)	0.7	4.5		0.7	2.7		mA	V_{CE} = 5.0 V H=1 mW/cm²
t_r	Light Current Rise Time (Note 5)		18			18		μs	
t_f	Light Current Fall Time (Note 5)		18			18		μs	

*Planar is a patented Fairchild process.

ELECTRICAL CHARACTERISTICS: $T_A = 25°C$

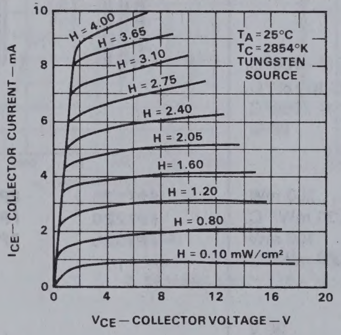
SYMBOL	CHARACTERISTIC	FPT120A			FPT130A			UNITS	TEST CONDITIONS
		MIN	TYP	MAX	MIN	TYP	MAX		
$I_{CE(lt)}$	Photo Current, Tungsten Source (Note 2)	1.5		4.5	0.9		2.7	mA	$V_{CE} = 5.0$ V $H = 1$ mW/cm²
		FPT120B			FPT130B				
$I_{CE(lt)}$	Photo Current, Tungsten Source (Note 2)	2.0		4.0	1.2		2.4	mA	$V_{CE} = 5.0$ V $H = 1$ mW/cm²
		FPT120C							
$I_{CE(lt)}$	Photo Current, Tungsten Source (Note 2)	16		25				mA	$V_{CE} = 5.0$ V $H = 5$ mW/cm²

NOTES:

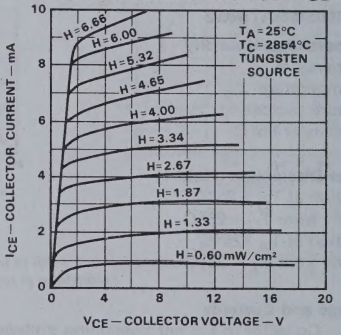
1. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
2. Measured at noted irradiance as emitted from a tungsten filament lamp at a color temperature of 2854°K. The effective photosensitive area is typically 1.25 mm² (FPT120A/B) and 0.78 mm² (FPT130A/B).
3. These are values obtained at noted irradiance as emitted from a GaAs source at 900 nm.
4. Measured with radiation flux intensity of less than .1 μW/cm² over the spectrum from 100-1500 nm.
5. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of peak value. Test conditions are: $V_{CE} = 5.0$ V, $I_{CC} = 4.0$ mA, $R_L = 100\ \Omega$, GaAs source.

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

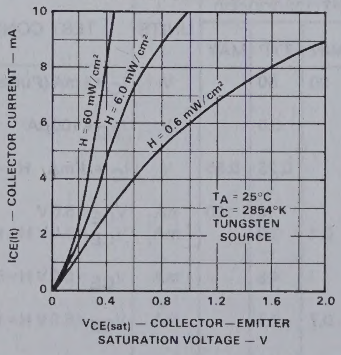
FPT 120A/120B/120C COLLECTOR CURRENT VERSUS COLLECTOR VOLTAGE



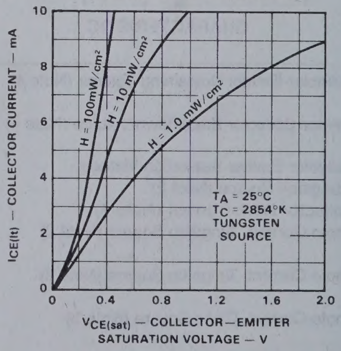
FPT 130A/130B COLLECTOR CURRENT VERSUS COLLECTOR VOLTAGE



COLLECTOR-EMITTER SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

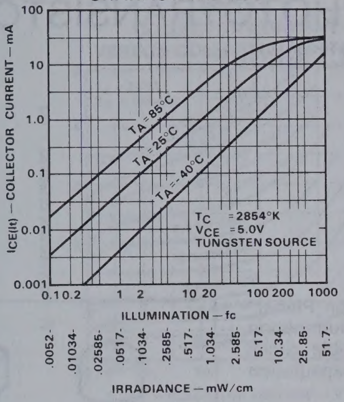


COLLECTOR-EMITTER SATURATION VOLTAGE VERSUS COLLECTOR CURRENT

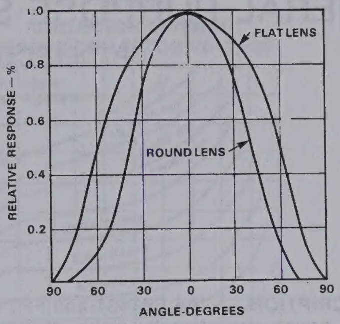


TYPICAL ELECTRICAL CHARACTERISTIC CURVES (Cont'd)

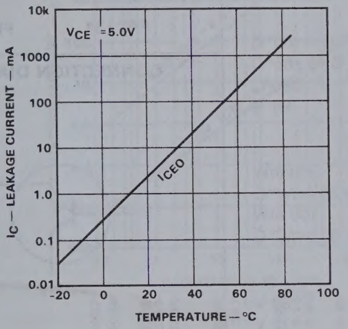
PHOTO CURRENT CHARACTERISTICS



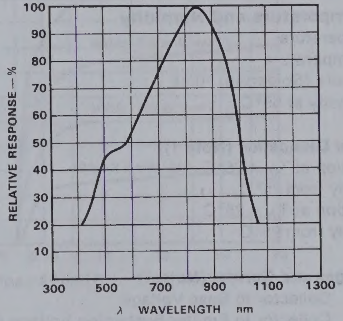
ANGULAR RESPONSE



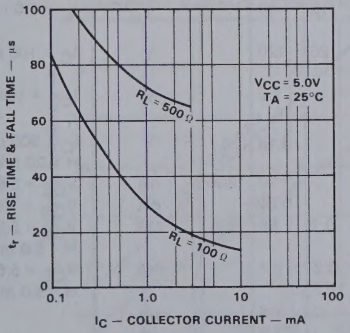
COLLECTOR DARK CURRENT VERSUS TEMPERATURE



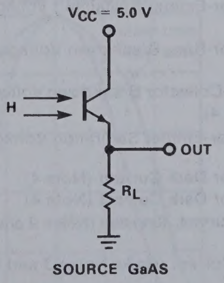
RELATIVE SPECTRAL RESPONSE



RISE AND FALL TIME VERSUS COLLECTOR CURRENT



SWITCHING TIME MEASUREMENT CIRCUIT



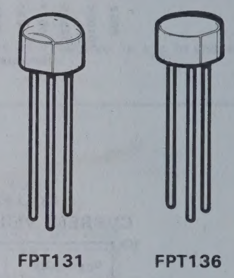
FPT131 • FPT136

GENERAL PURPOSE SILICON PHOTOTRANSISTORS

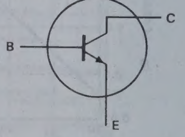
OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION — The FPT131 and FPT136 are 3-terminal npn Planar* phototransistors having exceptionally stable characteristics and high illumination sensitivity. The availability of the base pins gives wide latitude for flexible circuit design. The case is a special plastic compound with transparent resin encapsulation which exhibits stable characteristics under high humidity conditions.

- **HIGH ILLUMINATION SENSITIVITY**
- **AVAILABILITY OF BASE PINS FOR FLEXIBLE CIRCUIT DESIGN**
- **LOW COST**



CONNECTION DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	-55°C to +100°C
Operating Temperature	-55°C to +85°C
Pin Temperature (Soldering, 10 s)	260°C
Relative Humidity at 65°C	98 %

Maximum Power Dissipation (Note 1)

Total Dissipation at T_C = 25°C	200 mW
Derate Linearly from 25°C	3.33 mW/°C
Total Dissipation at T_A = 25°C	100 mW
Derate Linearly from 25°C	1.67 mW/°C

Maximum Voltages and Current (Note 4)

V_{CBO}	Collector to Base Voltage	20 V
V_{CEO}	Collector to Emitter Sustaining Voltage (Note 4)	15 V
I_C	Collector Current	25 mA

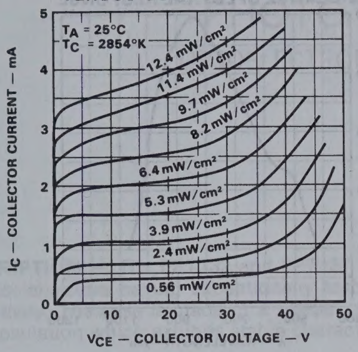
ELECTRICAL CHARACTERISTICS: T_A = 25°C

SYMBOL	CHARACTERISTIC	FPT131			FPT136			UNITS	TEST CONDITIONS
		MIN	TYP	MAX	MIN	TYP	MAX		
$V_{CEO(sus)}$	Collector-Emitter Sustaining Voltage (Note 4)	15	50		15	50		V	I_C = 1.0 mA (Pulsed)
BV_{CBO}	Collector-Base Breakdown Voltage (Note 4)	20	120		20	120		V	I_C = 100 μA
BV_{ECO}	Emitter-Collector Breakdown Voltage (Note 4)		7.0			7.0		V	I_{EC} = 100 μA
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage		0.16	0.7		0.16	0.7	V	I_C = 500 μA H = 20 mW/cm²
I_{CEO}	Collector Dark Current (Note 4)		10	500		10	500	nA	V_{CE} = 5.0 V
I_{CBO}	Collector Dark Current (Note 4)		0.25			0.25		nA	V_{CB} = 10 V
$I_{CE(lt)}$	Photo Current, Tungsten (Notes 2 and 6)	0.1	1.4		0.1	.88		mA	V_{CE} = 5.0 V H = 5.0 mW/cm²
$I_{CE(lt)}$	Photo Current (GaAs Notes 3 and 6)	0.2	4.2		0.2	2.7		mA	V_{CE} = 5.0 V H = 5.0 mW/cm²
t_r	Light Current Rise Time (Note 5)		2.8			2.8		μs	
t_f	Light Current Fall Time (Note 5)		2.8			2.8		μs	
R_{CB}	Responsivity, Tungsten (Notes 2 and 7)		1.6			1.0		μA/mW/cm²	V_{CB} = 10 V
R_{CB}	Responsivity, GaAs (Notes 3 and 7)		4.8			3.0		μA/mW/cm²	V_{CB} = 20 V

*Planar is a patented Fairchild process.

TYPICAL CHARACTERISTIC CURVES

FPT131 COLLECTOR CURRENT VERSUS COLLECTOR VOLTAGE



FPT136 COLLECTOR CURRENT VERSUS COLLECTOR VOLTAGE

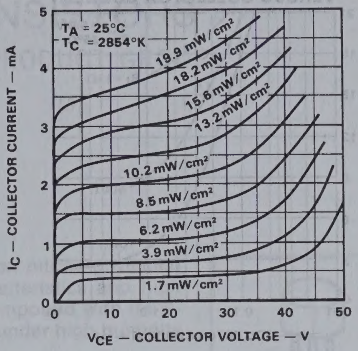
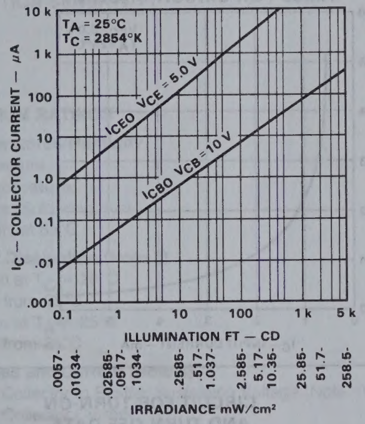
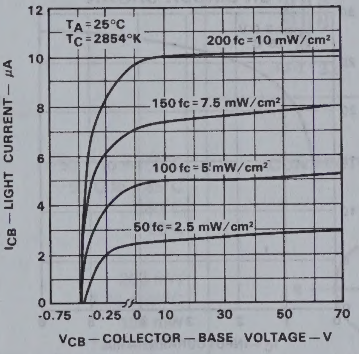


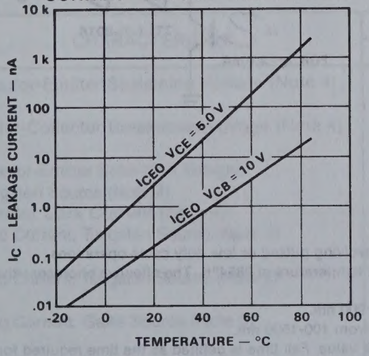
PHOTO CURRENT CHARACTERISTICS



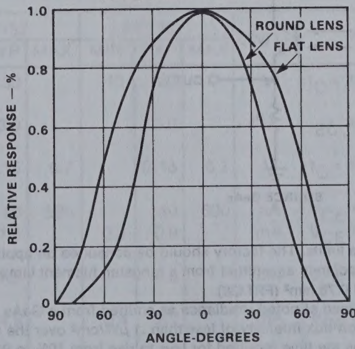
COLLECTOR BASE CHARACTERISTICS



COLLECTOR DARK CURRENT VERSUS TEMPERATURE

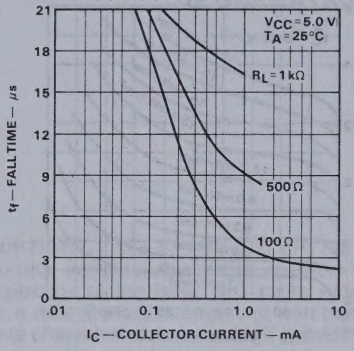


ANGULAR RESPONSE

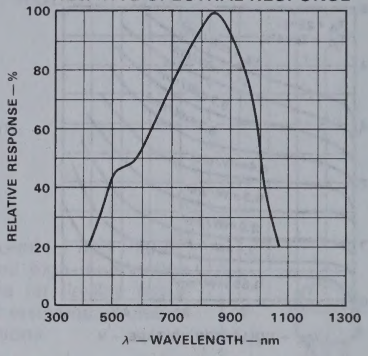


TYPICAL CHARACTERISTIC CURVES (Cont'd)

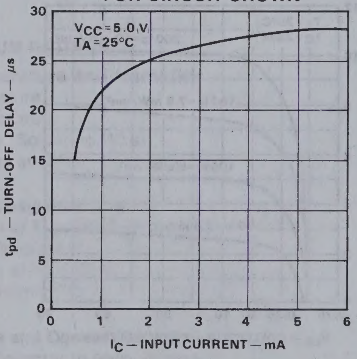
RISE AND FALL TIME VERSUS COLLECTOR CURRENT



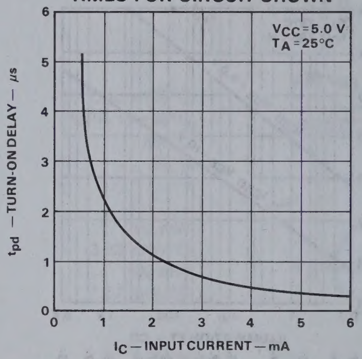
RELATIVE SPECTRAL RESPONSE



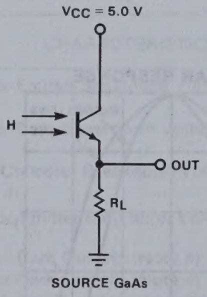
TURN-OFF TIMES FOR CIRCUIT SHOWN



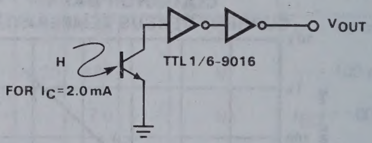
TURN-ON DELAY TIMES FOR CIRCUIT SHOWN



SWITCHING CIRCUIT FOR RISE AND FALL TIMES



CIRCUIT FOR TURN-ON AND TURN-OFF DATA



NOTES:

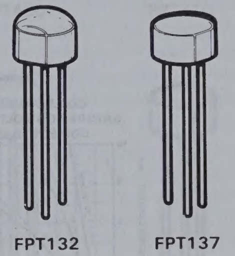
1. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
2. Measured at noted irradiance as emitted from a tungsten filament lamp at a color temperature of 2854°K. The effective photosensitive area is typically 1.25 mm² (FPT131) and 0.78 mm² (FPT136).
3. These are values obtained at noted irradiance as emitted from a GaAs source at 900 nm.
4. Measured with radiation flux intensity of less than .1 μW/cm² over the spectrum from 100-1500 nm.
5. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of peak value. Test conditions are: I_{CE} = 4.0 mA, V_{CE} = 5.0 V, R_L = 100 Ω, GaAs source.
6. No electrical connection to base pin.
7. No electrical connection to emitter pin.

FPT132 • FPT137

GENERAL PURPOSE, HIGH SENSITIVITY SILICON PHOTOTRANSISTORS

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION — The FPT132 and FPT137 are silicon nitride protected npn Planar* phototransistors having exceptionally stable characteristics and high illumination sensitivity. The case is made of a special plastic compound with transparent resin encapsulation which exhibits stable characteristics under high humidity conditions.



- **HIGH ILLUMINATION SENSITIVITY**
- **LOW COST**

ABSOLUTE MAXIMUM RATINGS

Maximum Temperatures/Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	98%

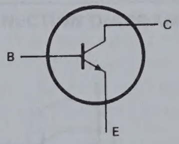
Maximum Power Dissipation (Note 3)

Total Dissipation at $T_C = 25°C$	200 mW
Derate Linearly from 25°C	3.33 mW/°C
Total Dissipation at $T_A = 25°C$	100 mW
Derate Linearly from 25°C	1.67 mW/°C

Maximum Voltages and Current (Note 4)

V_{CEO}	Collector to Emitter Sustaining Voltage (Note 4)	10 V
I_C	Collector Current	25 mA

CONNECTION DIAGRAM



ELECTRICAL CHARACTERISTICS: $T_A = 25°C$

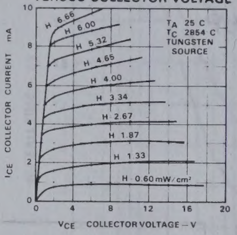
SYMBOL	CHARACTERISTIC	FPT132			FPT137			UNITS	TEST CONDITIONS
		MIN	TYP	MAX	MIN	TYP	MAX		
$V_{CEO(sus)}$	Collector-Emitter Sustaining Voltage (Note 4)	10	30		10	30		V	$I_C = 1$ mA (Pulsed)
BV_{ECO}	Emitter-Collector Breakdown Voltage (Note 4)		3.0			3.0		V	$I_{EC} = 100\ \mu A$
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage, Tungsten Source (Note 2)		0.15	0.7		0.15	0.7	V	$I_C = 1$ mA, H = 20 mW/cm²
I_{CEO}	Collector Dark Current (Note 4)		10	500		10	500	nA	$V_{CE} = 5.0$ V
$I_{CE(lt)}$	Photo Current, Tungsten Source (Note 2)	0.2	1.5		0.2	0.9		mA	$V_{CE} = 5.0$ V, H = 1 mW/cm²
$I_{CE(lt)}$	Photo Current, Tungsten Source (Note 2)		7.5			4.5		mA	$V_{CE} = 5.0$ V, H = 5 mW/cm²
$I_{CE(lt)}$	Photo Current, GaAs Source (Note 3)	0.4	4.5		0.4	2.7		mA	$V_{CE} = 5.0$ V, H = 1 mW/cm²
t_r	Light Current Rise Time (Note 5)		18			18		μs	
t_f	Light Current Fall Time (Note 5)		18			18		μs	

*Planar is a patented Fairchild process.

TYPICAL CHARACTERISTIC CURVES

FPT132

COLLECTOR CURRENT VERSUS COLLECTOR VOLTAGE



FPT137

COLLECTOR CURRENT VERSUS COLLECTOR VOLTAGE

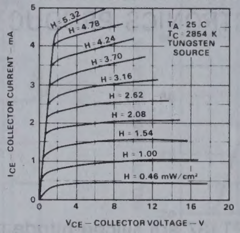
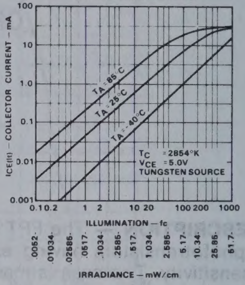
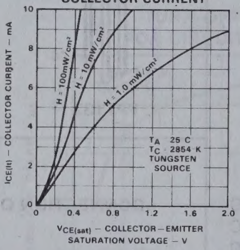


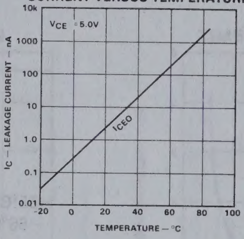
PHOTO CURRENT CHARACTERISTICS



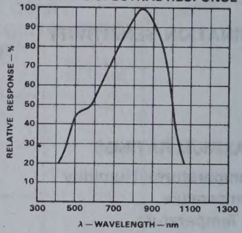
COLLECTOR-EMITTER SATURATION VOLTAGE VERSUS COLLECTOR CURRENT



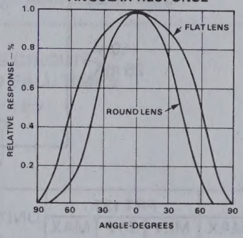
COLLECTOR DARK CURRENT VERSUS TEMPERATURE



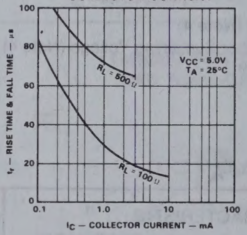
RELATIVE SPECTRAL RESPONSE



ANGULAR RESPONSE



RISE TIME AND FALL TIME VERSUS COLLECTOR CURRENT



NOTES:

1. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
2. Measured at noted irradiance as emitted from a tungsten filament lamp at a color temperature of 2854°K. The effective photosensitive area is typically 1.25 mm² (FPT132), and 0.78 mm² (FPT137).
3. These are values obtained at noted irradiance as emitted from a GaAs source at 900 nm.
4. Measured with radiation flux intensity of less than 1 μW/cm² over the spectrum from 100-1500 nm.
5. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of peak value. Test conditions are: V_{CE} = 5.0 V, I_{CE} = 4.0 mA, R_L = 100Ω, GaAs source.

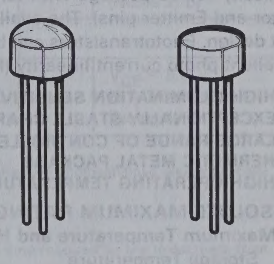
FPT400 • FPT410

VERY HIGH SENSITIVITY PHOTO-DARLINGTONS

OPTOELECTRONICS PRODUCT GROUP

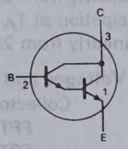
GENERAL DESCRIPTION – The FPT400 and FPT410 are 3-terminal npn Planar* photo-Darlingtons having exceptionally stable characteristics and high illumination sensitivity. The availability of the base pins gives wide latitude for flexible circuit design. The case is a special plastic compound with transparent resin encapsulation which exhibits stable characteristics under high humidity conditions.

FPT400 **FPT410**



- **SUPER HIGH ILLUMINATION SENSITIVITY**
- **EXCEPTIONALLY STABLE CHARACTERISTICS**
- **EXCELLENT FOR LOW LIGHT LEVEL APPLICATIONS**
- **HIGH OUTPUT CURRENT**

CONNECTION DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Maximum Temperatures and Humidity

Storage Temperature	−55°C to + 100°C
Operating Temperature	−55°C to +85°C
Relative Humidity at 65°C	98%

Maximum Power Dissipation (Note 7 and 8)

Total Dissipation at $T_C = 25°C$	200 mW
Derate Linearly from 25°C	3.3 mW/°C
Total Dissipation at $T_A = 25°C$	100 mW
Derate Linearly from 25°C	1.67 mW/°C

Maximum Voltages and Currents

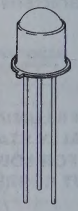
V_{CB}	Collector to Base Voltage	30 V
V_{CE}	Collector to Emitter Voltage	30 V
I_C	Collector Current	50 mA

ELECTRICAL CHARACTERISTICS: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
$V_{CEO(sus)}$	Collector-Emitter Sustaining Voltage	30	60		V	$I_C = 1.0$ mA (Note 3)
V_{CBO}	Collector-Base Voltage	30	60		V	$I_C = 100\ \mu A$ (Note 3)
V_{ECO}	Emitter-Collector Voltage		10		V	$I_E = 100\ \mu A$ (Note 3)
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage		0.9	1.0	V	$I_C = 5.0$ mA, H = 5.0 mW/cm² (Note 1)
I_{CEO}	Collector Dark Current		10	100	nA	$V_{CE} = 5.0$ V (Note 3)
$I_{CE(lt)}$	Photo Current (Tungsten)					
	FPT400	3.0	7.5		mA	$V_{CE} = 5.0$ V, H = 1.0 mW/cm²
	FPT410	2.0	5.0		mA	(Notes 1, 5)
$I_{CE(lt)}$	Photo Current (GaAs)					
	FPT400	6.0	15		mA	$V_{CE} = 5.0$ V, H = 1.0 mW/cm²
	FPT410	4.0	10		mA	(Notes 2, 5)
t_r	Light Current Rise Time		100		μs	(Note 4)
t_f	Light Current Fall Time		100		μs	(Note 4)

FPT500 • 520 • 540
FPT500A • 520A • 540A
HERMETIC TO-18 SILICON PHOTOTRANSISTORS
OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – FPT500/FPT520/FPT540 series are nitride-passivated npn Planar* silicon phototransistors. These devices are packaged in a TO-18 style, hermetically sealed package with lens cap. For most applications two pins are used (Collector and Emitter pins). The availability of base pin gives wide latitude for flexible circuit design. Phototransistors can be used as a photo diode (collector-base) which has an excellent photo current linearity (for analog applications).



- HIGH ILLUMINATION SENSITIVITY
- EXCEPTIONALLY STABLE CHARACTERISTICS
- LARGE RANGE OF CONTROLLED SENSITIVITIES
- HERMETIC METAL PACKAGE
- HIGH OPERATING TEMPERATURE

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	−65°C to +200°C
Operating Temperature	−55°C to +150°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	98%

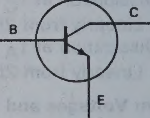
Maximum Power Dissipation

Total Dissipation at $T_C = 25°C$	600 mW
Derate Linearly from 25°C	4.8 mW/°C
Total Dissipation at $T_A = 25°C$	300 mW
Derate Linearly from 25°C	2.4 mW/°C

Maximum Voltages and Currents

V_{CB}	Collector to Base Voltage	
	FPT500/FPT500A	60 V
	FPT520/FPT520A	50 V
	FPT540/FPT540A	30 V
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage	
	FPT500/500A	45 V
	FPT520/FPT520A	30 V
	FPT540/FPT540A	12 V
I_C	Collector Current	50 mA

CONNECTION DIAGRAM



ELECTRICAL CHARACTERISTICS: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	FPT500/500A			FPT520/520A			FPT540/540A			UNITS	TEST CONDITIONS
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX		
$V_{CEO(sus)}$	Collector-Emitter Sustaining Voltage	45	60		30	60		12	30		V	$I_C = 1.0$ mA (Note 3)
V_{CBO}	Collector-Base Voltage	60	100		50	80		30	50		V	$I_C = 100\ \mu A$ (Note 3)
V_{EBO}	Emitter-Collector Voltage		10			10			7.0		V	$I_E = 100\ \mu A$ (Note 3)
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage		0.16	0.33		0.16	0.33				V	$I_C = 500\ \mu A$ (Note 1) $H = 2.0$ mW/cm²
									0.25	0.55	V	$I_C = 1.0$ mA (Note 1) $H = 2.0$ mW/cm²

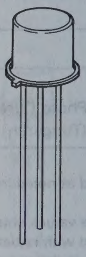
ELECTRICAL CHARACTERISTICS: T_A = 25°C (Cont'd)

SYMBOL	CHARACTERISTIC	FPT500/500A			FPT520/520A			FPT540/540A			UNITS	TEST CONDITIONS
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX		
I_{CEO}	Collector Dark Current		10	100		10	100		10	100	nA	V_{CE} = 5.0 V (Note 3)
I_{CBO}	Collector Dark Current		0.25	25		0.25	25		0.25	25	nA	V_{CB} = 10 V (Note 3)
$I_{CB(lt)}$	Photo Current		10			10			10		μA	V_{CB} = 5.0 V (Note 6) H = 1.0 mW/cm²
θ_{50}	50% Angular Response		15			15			15		degrees	
t_r	Light Current Rise Time		3.0			8.0			18		μs	(Note 4)
t_f	Light Current Fall Time		3.0			8.0			18		μs	(Note 4)
		FPT500			FPT520			FPT540				
$I_{CE(lt)}$	Photo Current (Tungsten)	1.0	3.0		5.0	8.0		8.0	15		mA	V_{CE} = 5.0 V H = 1.0 mW/cm² (Notes 1, 5)
$I_{CE(lt)}$	Photo Current (GaAs)	3.0	6.0		10	24		16	30		mA	V_{CE} = 5.0 V H = 1.0 mW/cm² (Notes 2, 5)
		FPT500A			FPT520A			FPT540A				
$I_{CE(lt)}$	Photo Current (Tungsten)	2.0		6.0	6.0		18	10		30	mA	V_{CE} = 5.0 V H = 1.0 mW/cm² (Notes 1, 5)

NOTES:

1. Measured at noted irradiance as emitted from a Tungsten filament lamp at a color temperature of 2854°K. The effective photosensitive area is typically 7 mm².
2. These are values obtained at noted irradiance as emitted from a GaAs source at 900 nm.
3. Measured with radiation flux intensity of less than 0.1 μW/cm² over the spectrum from 100-1500 nm.
4. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of peak value. Test conditions are: V_{CE} = 10 V, I_{CC} = 10 mA, R_L = 100 Ω, GaAs source.
5. No electrical connection to base pin.
6. No electrical connection to emitter pin.

FPT510 • 530 • 550
FPT510A • 530A • 550A
HERMETIC TO-18 SILICON PHOTOTRANSISTORS
OPTOELECTRONICS PRODUCT GROUP



GENERAL DESCRIPTION – FPT510/FPT530/FPT550 series are nitride-passivated npn Planar* silicon phototransistors. These devices are packaged in a TO-18 style, hermetically sealed package with lens cap. For most applications two pins are used (Collector and Emitter pins). The availability of base pin gives wide latitude for flexible circuit design. Phototransistors can be used as a photo diode (collector-base) which has an excellent photo current linearity (for analog applications).

- **HIGH ILLUMINATION SENSITIVITY**
- **EXCEPTIONALLY STABLE CHARACTERISTICS**
- **LARGE RANGE OF SENSITIVITIES**
- **HERMETIC METAL PACKAGE**
- **HIGH OPERATING TEMPERATURE**

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	−65°C to +200°C
Operating Temperature	−55°C to +150°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	98%

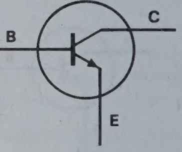
Maximum Power Dissipation

Total Dissipation at $T_C = 25°C$	600 mW
Derate Linearly from 25°C	4.8 mW/°C
Total Dissipation at $T_A = 25°C$	300 mW
Derate Linearly from 25°C	2.4 mW/°C

Maximum Voltages and Currents

V_{CB}	Collector to Base Voltage	
	FPT510/FPT510A	60 V
	FPT530/FPT530A	50 V
	FPT550/FPT550A	30 V
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage	
	FPT510/510A	45 V
	FPT530/FPT530A	30 V
	FPT550/FPT550A	12 V
I_C	Collector Current	50 mA

CONNECTION DIAGRAM



ELECTRICAL CHARACTERISTICS: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	FPT510/510A			FPT530/530A			FPT550/550A			UNITS	TEST CONDITIONS
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX		
$V_{CEO(sus)}$	Collector-Emitter Sustaining Voltage	45	60		30	60		12	30		V	$I_C = 1.0$ mA (Note 3)
V_{CBO}	Collector-Base Voltage	60	100		50	80		30	50		V	$I_C = 100$ µA (Note 3)
V_{EBO}	Emitter-Collector Voltage		10			10			7.0		V	$I_E = 100$ µA (Note 3)
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage		0.16	0.33		0.16	0.33				V	$I_C = 500$ µA (Note 1) H = 2.0 mW/cm²
									0.25	0.55	V	$I_C = 1.0$ mA (Note 1) H = 2.0 mW/cm²

ELECTRICAL CHARACTERISTICS: $T_A = 25°C$ (Cont'd)

SYMBOL	CHARACTERISTIC	FPT510/510A			FPT530/530A			FPT550/550A			UNITS	TEST CONDITIONS
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX		
I_{CEO}	Collector Dark Current		10	100		10	100		10	100	nA	$V_{CE} = 5.0$ V (Note 3)
I_{CBO}	Collector Dark Current		0.25	25		0.25	25		0.25	25	nA	$V_{CB} = 10$ V (Note 3)
$I_{CB(lt)}$	Photo Current		5.0			5.0			5.0		μA	$V_{CB} = 5.0$ V (Note 6) $H = 5.0$ mW/cm²
θ_{50}	50% Angular Response		15			15			15		degrees	
t_r	Light Current Rise Time		3.0			8.0			18		μs	(Note 4)
t_f	Light Current Fall Time		3.0			8.0			18		μs	(Note 4)
		FPT510			FPT530			FPT550				
$I_{CE(lt)}$	Photo Current (Tungsten)	0.5	1.5		3.0	5.0		8.0	10		mA	$V_{CE} = 5.0$ V $H = 5.0$ mW/cm² (Notes 1, 5)
$I_{CE(lt)}$	Photo Current (GaAs)	1.5	4.5		6.0	15		16	30		mA	$V_{CE} = 5.0$ V $H = 5.0$ mW/cm² (Notes 2, 5)
		FPT510A			FPT530A			FPT550A				
$I_{CE(lt)}$	Photo Current (Tungsten)	1.0		3.0	4.0		12	8.0		24	mA	$V_{CE} = 5.0$ V $H = 5.0$ mW/cm² (Notes 1, 5)

NOTES:

1. Measured at noted irradiance as emitted from a Tungsten filament lamp at a color temperature of 2854°K. The effective photosensitive area is typically 7 mm².
2. These are values obtained at noted irradiance as emitted from a GaAs source at 900 nm.
3. Measured with radiation flux intensity of less than 0.1 μW/cm² over the spectrum from 100-1500 nm.
4. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of peak value. Test conditions are: $V_{CE} = 10$ V, $I_{CC} = 10$ mA, $R_L = 100\ \Omega$, GaAs source.
5. No electrical connection to base pin.
6. No electrical connection to emitter pin.

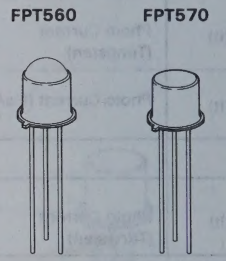
FPT560 • FPT570

VERY HIGH SENSITIVITY PHOTO-DARLINGTONS

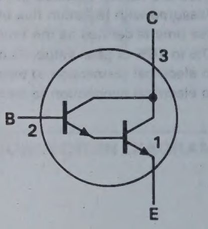
OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – FPT560/FPT570 are nitride passivated silicon photo Darlingtons. Each device is packaged in a TO-18 style, hermetically sealed package with lens cap. For most applications two pins are used (Collector and Emitter pins). The availability of base pin gives wide latitude for flexible circuit design.

- **SUPER HIGH ILLUMINATION SENSITIVITY**
- **EXCEPTIONALLY STABLE CHARACTERISTICS**
- **EXCELLENT FOR LOW LIGHT LEVEL APPLICATIONS**
- **HIGH OUTPUT CURRENT**



CONNECTION DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	−65°C to +200°C
Operating Temperature	−55°C to +150°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	98%

Maximum Power Dissipation

Total Dissipation at $T_C = 25°C$	600 mW
Derate Linearly from 25°C	4.8 mW/°C
Total Dissipation at $T_A = 25°C$	300 mW
Derate Linearly from 25°C	2.4 mW/°C

Maximum Voltages and Currents

V_{CB}	Collector to Base Voltage	30 V
V_{CE}	Collector to Emitter Voltage	30 V
I_C	Collector Current	125 mA

ELECTRICAL CHARACTERISTICS: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
$V_{CEO(sus)}$	Collector-Emitter Sustaining Voltage	30	60		V	$I_C = 1.0$ mA (Note 3)
V_{CBO}	Collector-Base Voltage	30	60		V	$I_C = 100\ \mu A$ (Note 3)
V_{ECO}	Emitter-Collector Voltage		10		V	$I_E = 100\ \mu A$ (Note 3)
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage		0.9	1.0	V	$I_C = 25$ mA, $H = 2.0$ mW/cm² (Note 1)
I_{CEO}	Collector Dark Current		10	100	nA	$V_{CE} = 5.0$ V (Note 3)
$I_{CE(lt)}$	Photo Current (Tungsten)					
	FPT560	10	30		mA	$V_{CE} = 5.0$ V, $H = 1.0$ mW/cm²
	FPT570	1.0	6.0		mA	(Notes 1, 5)
$I_{CE(lt)}$	Photo Current (GaAs)					
	FPT560	30	90		mA	$V_{CE} = 5.0$ V, $H = 1.0$ mW/cm²
	FPT570	3.0	18		mA	(Notes 2, 5)
θ_{50}	50% Response Angle		15		degrees	
t_r	Light Current Rise Time		100		μs	(Note 4)
t_f	Light Current Fall Time		100		μs	(Note 4)

NOTES:

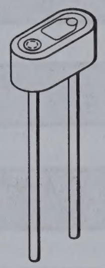
1. Measured at noted irradiance as emitted from a Tungsten filament lamp at a color temperature of 2854°K. The effective photosensitive area is typically 7 mm².
2. These are values obtained at noted irradiance as emitted from a GaAs source at 900 nm.
3. Measured with radiation flux intensity of less than 0.1 μW/cm² over the spectrum from 100-1500 nm.
4. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of peak value. Test conditions are: $V_{CE} = 10$ V, $I_{CC} = 10$ mA, $R_L = 100\ \Omega$, GaAs source.
5. No electrical connection to base pin.
6. No electrical connection to emitter pin.

FPT610 • FPT630

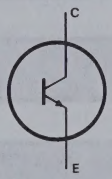
MINIATURE CERAMIC SILICON PHOTOTRANSISTORS

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The FPT610 and FPT630 are miniature phototransistors having exceptional stable characteristics. They utilize a ceramic case with transparent resin encapsulation. The spectral response, extending from 400 to 1100 nm, is compatible with daylight, tungsten and gallium arsenide sources.



CONNECTION DIAGRAM



- **HIGH ILLUMINATION SENSITIVITY**
- **EXCEPTIONALLY STABLE CHARACTERISTICS**
- **CAN BE STAKED ON .087" CENTERS**
- **MINIATURE – 85 x 185 x 95 MILS HIGH**

ABSOLUTE MAXIMUM RATINGS

Maximum Temperature and Humidity

Storage Temperature	−40°C to +100°C
Operating Temperature	−40°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	98%

Maximum Power Dissipation

Total Dissipation at $T_A = 25°C$	100 mW
Derate Linearly from 25°C	1.33 mW/°C

Maximum Voltages and Currents

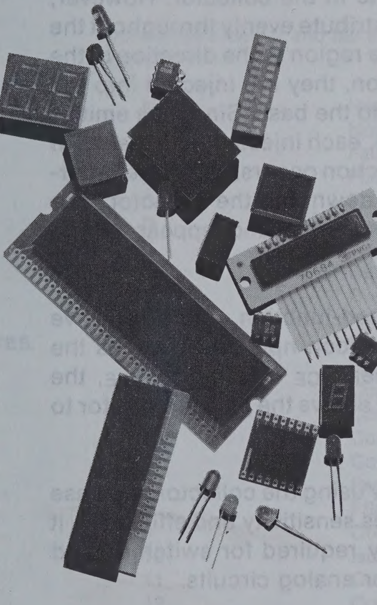
$V_{CE(sus)}$	Collector to Emitter Sustaining Voltage	
	FPT610	30 V
	FPT630	20 V
I_C	Collector Current	50 mA

ELECTRICAL CHARACTERISTICS: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	FPT610			FPT630			UNITS	TEST CONDITIONS
		MIN	TYP	MAX	MIN	TYP	MAX		
$V_{CEO(sus)}$	Collector-Emitter Sustaining Voltage (Note 1)	30	60		20	40		V	$I_C = 1.0$ mA
V_{ECO}	Emitter-Collector Voltage (Note 1)		10			10		V	$I_E = 100\ \mu A$
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage (Note 2)		0.16	0.33		0.16	0.33	V	$I_C = 500\ \mu A$ $H = 20$ mW/cm²
I_{CEO}	Collector Dark Current (Note 1)		10	100		10	100	nA	$V_{CE} = 5.0$ V
$I_{CE(lt)}$	Photo Current (Tungsten) (Note 2)	0.2	1.0		2.0	5.0		mA	$V_{CE} = 5.0$ V $H = 5.0$ mW/cm²
$I_{CE(lt)}$	Photo Current (GaAs) (Note 3)	0.4	3.0		4.0	15		mA	$V_{CE} = 5.0$ V $H = 5.0$ mW/cm²
t_r	Rise Time (Note 4)		3.0			18		μs	$I_C = 2.0$ mA, $R_L = 100\ \Omega$
t_f	Fall Time (Note 4)		3.0			18		μs	$I_C = 2.0$ mA, $R_L = 100\ \Omega$

NOTES:

1. Measured with radiation flux intensity of less than 0.1 μW/cm² over the spectrum from 100 – 1500 nm.
2. Measured at noted irradiance as emitted from a Tungesten filament lamp at a color temperature of 2854°K.
3. These are values obtained at noted irradiance as emitted from A GaAs source at 900 nm.
4. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of peak value. Test conditions are: $I_{CE} = 4.0$ mA, $V_{CE} = 5.0$ V, $R_L = 100\ \Omega$, GaAs Source.



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CHAPTER 6
INTRODUCTION

Phototransistor operation is a result of the photo-effect in certain types of semiconductors. Light of the proper wavelength generates hole-electron pairs within the transistor, and an applied voltage causes these carriers to move, resulting in current flow. The intensity of the applied light determines the number of carrier pairs and, therefore, the magnitude of the resultant current.

In a phototransistor, the actual carrier generation takes place in the vicinity of the collector-base junction. A hole generated in the base remains there, while a hole generated in the collector is drawn into the base by the strong field at the junction. The same process results in electrons tending to accumulate in the collector. However, charge does not actually accumulate; rather, it tries to distribute evenly throughout the bulk regions. Consequently, holes diffuse across the base region in the direction of the base-emitter junction. When the holes reach this junction, they are injected into the emitter, causing the emitter in turn to inject electrons into the base. Since the emitter injection efficiency is much greater than that of the base, each injected hole results in many injected electrons. At this point, normal transistor action occurs, with the emitter-injector electrons migrating across the base and being down into the collector. The injected electrons combine with the photo-induced electrons and appear as the terminal-collector current.

A phototransistor may thus be considered to be a diffused-junction, photo-sensitive diode in parallel with the collector-base junction of a silicon npn transistor. as the current increases, the collector voltage decreases. When V_{CE} is equal to V_{BE}, the photocurrent source becomes a photovoltaic source and allows the phototransistor to saturate.

A phototransistor may be used as a photodiode simply by using the collector and base leads and leaving the emitter open. Although this reduces sensitivity and efficiency, it does increase speed. Photodiode operation is generally required for switching and digital applications; phototransistor operation is used for analog circuits.

INFRARED-EMITTING LEDs

An infrared-emitting LED (IRLED) is identical to a visible LED, except that zinc is diffused into the gallium arsenide compound. The resulting pn junction emits light in the 890-nanometer wave-length range. This light is invisible to the human eye, but is ideally matched to the spectral response of silicon photodetectors. When used in conjunction with photodiodes or phototransistors, IRLEDs form a system offering useful ac and dc characteristics. For both large, fixed equipment and portable, battery-operated equipment, this combination of devices offers the following features:

Low cost
High-speed operation
High reliability
Low power requirements
Small size
Integrated circuit campatibility.

COUPLER CROSS REFERENCE KEY

COMPETITOR:

GE	General Electric
HP	Hewlett-Packard
LIT	Litronix
MON	Monsanto
MOT	Motorola
TI	Texas Instruments

MIN CTR:

Minimum current transfer ratio with $V_{CE} = 10$ V, $I_F = 10$ mA

MIN ISO VOLTAGE:

Minimum isolation voltage (peak) in volts (dc)

TYPICAL RESPONSE TIME:

Typical rise time (tr) and fall time (tf) in microseconds under test conditions $R_L = 100\ \Omega$, $I_C = 2$ mA, $V_{CE} = 10$ V

CODE:

NC-P	Not crossable because of package differences
NC-E	Not crossable because of electrical differences
A	Fairchild device is a direct replacement
B	Fairchild device is easily crossable with minor electrical deviations as noted
C	Fairchild device is easily crossable with minor mechanical deviations as noted
D	Significant electrical differences between devices as noted
E	Significant mechanical differences between devices as noted
X	Direct replacement available 2nd quarter 1978
Y	Device could be easily crossed with high volume order.

NOTES:

1	Competitor device is 8 lead plastic dip package
2	Competitor device has different pin-out
3	Competitor device is logic gate with open collector
4	Competitor device is TO-18 metal can package
5	Competitor device is reliability conditioned
6	Competitor device is dual channel
7	Package dimension difference between devices
8	FSC device has transistor output
9	Competitor device is slotted coupler
10	Isolation voltage on competitor device is tested 1 second rms
11	Competitor device has special electrical: $V_{CEO} = 80$ V, $V_{CBO} = 80$ V, $V_{ECO} = 7$ V
12	Competitor device specified with special test circuit
13	Competitor device has 2 emitters; ac or polarity insensitive inputs
14	Competitor device has $BV_{CEO} = 55$ V minimum
15	Competitor device has $V_F = 1.0$ V typical, 1.15 V max at $I_F = .5$ mA
16	Competitor device is a reflective array
17	Competitor device is a matched emitter-detector pair
18	Competitor device is in a clear epoxy package
19	Competitor device has 4 channels in a 16 lead plastic dip package
20	Competitor device has $BV_{CEO} = 80$ V min.
21	Competitor device is a DTL/TTL compatible optically isolated gate
22	Competitor device has TTL compatible input and output
23	Competitor device has 16 pin dual inline ceramic package
24	Competitor device has hermetic package
25	Motorola device has 20% CTR min. GE device is a 10% CTR min.
26	Motorola device has isolation voltage of 2500 V_{dc} min.
27	Same device as HP 6N137
28	Same device as HP 6N138
29	Same device as HP 6N139
30	Response time test condition/measurement difference
31	Same device as HP 6N135
32	Same device as HP 6N136

NOTES (cont'd):

33 Same device as HCPL-2502
34 Same device as HCPL-2530
35 Same device as HCPL-2531
36 Same device as HCPL-2601
37 Same device as HCPL-2630
38 Same device as 6N134
39 Same device as 6N134TXV
40 Same device as 6N134TXVB
41 FCS cross is selected from device listed
42 High V_{CEO} couplers (200 V-300 V)
43 Competition specifications not available at this time
44 Min ISO voltage test condition/measurement difference
45 Min CTR test condition/measurement difference

COUPLER CROSS REFERENCE

DEVICE	COMPETITOR	OUTPUT DEVICE	MIN CTR (%)	MIN ISO VOLTAGE (V)	TYPICAL RESPONSE TIME (t_r — (µs)	t_f)	FAIRCHILD DEVICE	CODE	NOTES
4N22	TI	Transistor	25	1000	15	15		NC-P	2,24
4N23	TI	Transistor	60	1000	15	15		NC-P	2,24
4N24	TI	Transistor	100	1000	15	15		NC-P	2,24
4N25	MON/GE/MOT	Transistor	20	2500	2.5	2.6	4N25	A	
4N25A	GE/MOT	Transistor	20	1775	2.5	2.6	4N25	A/Y	10,26
4N26	MON/GE/MOT	Transistor	20	1500	2.5	2.6	4N26	A	
4N27	MON/GE/MOT	Transistor	10	1500	2.5	2.6	4N27	A	
4N28	MON/GE/MOT	Transistor	10	500	2.5	2.6	4N28	A	
4N29	MON/GE/MOT	Darlington	100	2500	.6	17	4N29	A	30
4N29A	GE/MOT	Darlington	100	1775	.6	17	4N29	A/Y	10,26
4N30	MON/GE/MOT	Darlington	100	1500	.6	17	4N30	A	30
4N31	MON/GE/MOT	Darlington	50	1500	.6	17	4N31	A	30
4N32	MON/GE/MOT	Darlington	500	2500	.6	45	4N32	A	30
4N32A	GE/MOT	Darlington	500	1775	.6	45	4N32	A/Y	10,26
4N33	MON/GE/MOT	Darlington	500	1500	.6	45	4N33	A	30
4N35	MON/GE/MOT	Transistor	100	3550	5	5	4N35	A	
4N36	MON/GE/MOT	Transistor	100	2500	5	5	4N36	A	
4N37	MON/GE/MOT	Transistor	100	1500	5	5	4N37	A	
4N38	GE/MOT	Transistor	10	1500	5	5		Y	11,25
4N38A	GE/MOT	Transistor	10	2500	5	5		Y	11,25,26
4N39	GE	SCR		1500				NC-E	
4N40	GE	SCR		1500				NC-E	
4N45	HP	Darlington	200	3000	5	150		NC-E	2,30
4N46	HP	Darlington	200	3000	5	150		NC-E	2,30
6N134	HP	Logic Gate		1500	.065	.055		NC-E	6,22,23,24
6N134TXV	HP	Logic Gate		1500	.065	.055		NC-E	6,22,23,24
6N134TXVB	HP	Logic Gate		1500	.065	.055		NC-E	5,6,22,23,24
6N135	HP	Transistor	7	3000	.5	.4		NC-E	1,2,30
6N136	HP	Transistor	19	3000	.2	.3		NC-E	1,2,30
6N137	HP	Logic Gate	600	3000	.025	.025		NC-E	1,2,21,30
6N138	HP	Photo Diode	300	3000	5	5		NC-E	1,2,30
6N139	HP	Photo Diode	400	3000	1	4		NC-E	1,2,30
5082-4350	HP	Photo Circuit	7	3000	.5	.4		NC-E	1,2,30,31
5082-4351	HP	Transistor	19	3000	.2	.3		NC-E	1,2,30,32
5082-4352	HP	Transistor	15	3000	.2	.3		NC-E	1,2,30,33
5082-4354	HP	Transistor	7	3000	.3	.4		NC-E	1,2,6,30,34
5082-4355	HP	Transistor	19	3000	.2	.3		NC-E	1,2,6,30,35
5082-4360	HP	Logic Gate	600	3000	.025	.025		NC-E	1,2,21,27,30

COUPLER CROSS REFERENCE KEY (cont'd)

DEVICE	COMPETITOR	OUTPUT DEVICE	MIN CTR (%)	MIN ISO VOLTAGE (V)	TYPICAL RESPONSE TIME (t_r	— t_f) (μs)	FAIRCHILD DEVICE	CODE	NOTES
5082-4361	HP	Logic Gate		3000	.025	.015		NC-E	1,2,22,30,36
5082-4364	HP	Gate		3000	.025	.025		NC-E	1,2,6,30,37
5082-4365	HP	Logic Gate		1500	.065	.055		NC-E	6,22,23,24,38
5082-4370	HP	Photo Diode	300	3000	5	5		NC-E	1,2,28,30
5082-4371	HP	Photo Diode	400	3000	1	4		NC-E	1,2,29,30
HCPL-2502	HP	Transistor	15	3000	.2	.3		NC-E	1,2,30
HCPL-2530	HP	Transistor	7	3000	.3	.4		NC-E	1,2,6,30
HCPL-2531	HP	Transistor	19	3000	.2	.3		NC-E	1,2,6,30
HCPL-2601	HP	Logic Gate		3000	.025	.025		NC-E	1,2,22,30
HCPL-2602	HP	Photo Circuit		3000	.025	.015		NC-E	1,2,30
HCPL-2630	HP	Gate		3000	.025	.025		NC-E	1,2,30
HCPL-2730	HP	Photo Circuit	300	3000	5	10		NC-E	1,2,6,22,30
HCPL-2731	HP	Photo Circuit	400	3000	5	10		NC-E	1,2,6,22,30
HCPL-2770	HP	Photo Circuit	300	1500	10	2		NC-E	23,24,30
TX4365	HP	Logic Gate		1500	.065	.055		NC-E	6,22,23,24,39
TXB4365	HP	Logic Gate		1500	.065	.055		NC-E	5,6,22,23,24,4
TXHCPL2770	HP	Photo Circuit	300	1500	10	2		NC-E	23,24,30
TXBHCPL2770	HP	Photo Circuit	300	1500	10	2		NC-E	5,23,24,30
H11A1	GE	Transistor	50	2500	2	2	H11A1	A	
H11A2	GE	Transistor	20	1500	2	2	H11A2	A	
H11A3	GE	Transistor	20	2500	2	2	H11A3	A	
H11A4	GE	Transistor	10	1500	2	2	H11A4	A	
H11A5	GE	Transistor	30	1500	2	2	FCD820A	Y	41
H11A10	GE	Transistor	10	1500	5	5	FCD810A	Y	12,41
H11A520	GE	Transistor	20	5000	5	5	FCD820D	A	
H11A550	GE	Transistor	50	5000	5	5	FCD825D	A	
H11A5100	GE	Transistor	100	5000	5	5	4N35	D/Y	41
H11AA1	GE	Transistor	20	1500				NC-E	13
H11AA2	GE	Transistor	10	1500				NC-E	13
H11B1	GE	Darlington	500	2500	125	100	H11B1	A	
H11B2	GE	Darlington	200	1500	125	100	H11B2	A	
H11B3	GE	Darlington	100	1500	125	100	FCD850	A	
H11B255	GE	Darlington	100	1500	125	100	FCD855	B	14
H11BX522	GE	Darlington	200	2500			FCD860C	B	15
H11C1	GE	SCR		2500				NC-E	
H11C2	GE	SCR		2100				NC-E	
H11C3	GE	SCR		1500				NC-E	
H11C4	GE	SCR		2500				NC-E	
H11C5	GE	SCR		2100				NC-E	
H11C6	GE	SCR		1500				NC-E	
H11D1	GE	Transistor	20	2500	5	5		NC-E	42
H11D2	GE	Transistor	20	1500	5	5		NC-E	42
H11D3	GE	Transistor	20	1500	5	5		NC-E	42
H11D4	GE	Transistor	10	1500	5	5		NC-E	42
H13A1	GE	Transistor			5	5		NC-P	9
H13A2	GE	Transistor			5	5		NC-P	9
H13B1	GE	Darlington			150	150		NC-P	9
H13B2	GE	Darlington			150	150		NC-P	9
H15A1	GE	Transistor	20	5650	3	3	FPA108	D	7,16
H15A2	GE	Transistor	10	5650	3	3	FPA108	D	7,16
H15B1	GE	Darlington	400	5650	125	100		D/Y	7,16,30
H15B2	GE	Darlington	200	5650	125	100		D/Y	7,16,30
H17A1	GE	Transistor			5	5	FPT610	E	17
H17B1	GE	Darlington			150	150	FPE106 FP106 FPT610	E	8,17,30
H19A1	GE	Transistor			5	5		NC-P	17,18
H19B1	GE	Darlington			150	150		NC-P	17,18
H74A1	GE	Transistor		1500				NC-E	22
H74C1	GE	SCR		1500				NC-E	
H74C2	GE	SCR		1500				NC-E	
IL1	LIT	Transistor	20	2500	2	2	IL1	A	
IL5	LIT	Transistor	50	2500	2	2	FCD825B	A	30
IL12	LIT	Transistor	10	1000	2	2	IL12	A	
IL15	LIT	Transistor	6	1500	2	2	IL15	A	

COUPLER CROSS REFERENCE KEY (cont'd)

DEVICE	COMPETITOR	OUTPUT DEVICE	MIN CTR (%)	MIN ISO VOLTAGE (V)	TYPICAL RESPONSE TIME (t_r —	t_f) (μs)	FAIRCHILD DEVICE	CODE	NOTES
IL16	LIT	Transistor	6	1500	2	2	IL16	A	
IL74	LIT	Transistor	125	1500	6	25	IL74	A	30
IL100	LIT	Photo Circuit (K)	1000 Typ	2500	.015	.015		NC-E	1,30
IL101	LIT	Photo Circuit (K)	1000 Typ	1500	.015	.015		NC-E	1,30
ILA30	LIT	Darlington	100	1500	10	35	MCA230	A	30
ILA55	LIT	Darlington	100	1500	10	35	MCA255	A	30
ILD74	LIT	Transistor	125	1500	6	25		NC-E	1,6,30
ILQ74	LIT	Transistor	125	1500	6	25		NC-E	19,30
ILCA2-30	LIT	Darlington	100	1500	10	35	MCA230	A	30
ILCA2-55	LIT	Darlington	100	1500	10	35	MCA255	A	30
ILCT6	LIT	Transistor	50	1500	2.4	2.4		NC-P	1,6
MCA7	MON	Darlington	0.1		600	600		D/Y	2,7,8,16
MCA8	MON	Darlington	15		300	1000		NC-P	9
MCA81	MON	Darlington	4		150	200		NC-P	9
MCA230	MON	Darlington	100	1500	5	35	MCA230	A	
MCA231	MON	Darlington	200	1500	5	35	MCA231	A	
MCA255	MON	Darlington	100	1500	5	35	MCA255	A	
MCL600	MON	Logic Gate						NC-E	1,43
MCL601	MON	Logic Gate		2000	.01	.01		NC-E	1,3
MCL610	MON	Logic Gate						NC-E	1,43
MCL611	MON	Logic Gate		2000	.01	.01		NC-E	1,3
MCT2	MON	Transistor	20	1500	2.5	2.6	MCT2	A	
MCT2E	MON	Transistor	20	2500	2.5	2.6	MCT2	A	
MCT4	MON	Transistor	15	1000	2	2		NC-P	2,4
MCT4R	MON	Transistor	15	1000	2	2		NC-P	2,4,5
MCT6	MON	Transistor	20	1500	2.4	2.4		X	1,2,6
MCT8	MON	Transistor			3	4		NC-P	9
MCT26	MON	Transistor	6	1500	2	2	MCT26	A	
MCT66	MON	Transistor	6	1500	2.4	2.4		X	1,2,6
MCT210	MON	Transistor	150	4000	4	5	4N35	D/Y	41
MCS2	MON	SCR		1500				NC-E	
MCS2400	MON	SCR		1500				NC-E	
MCS6200	MON	Dual SCR		1500				NC-E	1
MCS6201	MON	Dual SCR		2500				NC-E	1
MCT271	MON	Transistor							43
MCT272	MON	Transistor							43
MCT273	MON	Transistor							43
MCT274	MON	Transistor							43
MCT275	MON	Transistor							43
MCT276	MON	Transistor							43
MCT277	MON	Transistor							43
MCT81	MON	Transistor			3	4		NC-P	9
MOC119	MOT	Darlington	300	1500			TIL119	A	
MOC1005	MOT	Transistor	20	5000			FCD820C	A	
MOC1006	MOT	Transistor	10	5000			FCD810C	A	
MOC1200	MOT	Darlington	100	1500			4N30	A	
MOC8030	MOT	Darlington	300	1500				NC-E	20
MOC8050	MOT	Darlington	500	1500				NC-E	20
MOC3000	MOT	Photo Circuit		5000				NC-E	
MOC3001	MOT	Photo Circuit		5000				NC-E	
MOC3002	MOT	Photo Circuit	5000					NC-E	
MOC3003	MOT	Photo Circuit	5000					NC-E	
MOC5000	MOT	Photo Circuit	1500	.250	.65			NC-E	
MOC5001	MOT	Photo Circuit		500	.3	.4		NC-E	
TIL102	TI	Transistor	25	1000	3	3		NC-P	2,24,30
TIL103	TI	Transistor	100	1000	6	6		NC-P	2,24,30
TIL107	TI	Transistor	3	1000	5	5		NC-P	2,24,30
TIL108	TI	Transistor	10	1000	5	5		NC-P	2,24,30
TIL109	TI	Transistor	.7	5000	5	5		NC-P	2,30
TIL111	TI	Transistor	12	1500	2	2	TIL111	A	
TIL112	TI	Transistor	2	1500	2	2	TIL112	A	
TIL113	TI	Darlington	300	1500	50	50	TIL113	A	30
TIL114	TI	Transistor	12	2500	2	2	TIL114	A	
TIL115	TI	Transistor	2	1500	2	2	TIL115	A	
TIL116	TI	Transistor	20	2500	2	2	TIL116	A	
TIL117	TI	Transistor	50	2500	2	2	TIL117	A	

COUPLER CROSS REFERENCE

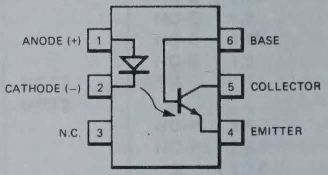
DEVICE	COMPETITOR	OUTPUT DEVICE	MIN CTR (%)	MIN ISO VOLTAGE (V)	TYPICAL RESPONSE TIME (t_r — t_f) (μs)		FAIRCHILD DEVICE	CODE	NOTES
TIL118	TI	Transistor	10	1500	2	2	TIL118	A	
TIL119	TI	Darlington	300	1500	50	50	TIL119	A	30
TIL120	TI	Transistor	25	1000	3	3		NC-P	2,24
TIL121	TI	Transistor	50	1000	6	6		NC-P	2,24

FCD810 • FCD810C
OPTICALLY-COUPLED ISOLATOR
OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The FCD810 series of optoisolators combines a gallium arsenide infrared emitting diode and a silicon npn phototransistor in close proximity. Optical intercoupling provides a high degree of ac and dc isolation. A capability for continuous operation of the input diode results in a frequency response extending to dc. Connection to the transistor base is also provided for design flexibility.

- **GLASSOLATED™**
- **1500 V TO 6000 V MINIMUM ISOLATION INPUT-TO-OUTPUT**
- **10^{11} Ω ISOLATION RESISTANCE**
- **LOW COUPLING CAPACITANCE – TYPICALLY 1.0 pF**

CONNECTION DIAGRAM
DIP (TOP VIEW)



PIN NUMBERS

1	Anode (+)	Input Diode
2	Cathode (–)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

ABSOLUTE MAXIMUM RATINGS

Storage Temperature		−55°C to +150°C
Operating Temperature		−55°C to +100°C
Pin Temperature (Soldering, 5 s)		260°C
Total Package Power Dissipation at T_A = 25°C (LED plus Detector)		250 mW
Derate Linearly from 25°C		3.3 mW/°C
INPUT DIODE		
V_R	Reverse Voltage	3.0 V
I_F	Forward Current	60 mA
i_f	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at T_A = 25°C	100 mW
	Derate Linearly from 25°C	1.33 mW/°C
OUTPUT TRANSISTOR		
V_{CE}	Collector to Emitter Voltage	20 V
V_{CB}	Collector to Base Voltage	50 V
I_C	Collector Current	25 mA
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

ELECTRICAL CHARACTERISTICS – INPUT DIODE: T_A = 25°C

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.2	1.5	V	I_F = 10 mA
BV_R	Reverse Breakdown Voltage	3.0	8.0		V	I_R = 1.0 mA

ELECTRICAL CHARACTERISTICS – OUTPUT TRANSISTOR: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{CEO}	Collector-Emitter Voltage	20	50		V	$I_C = 1.0$ mA, $I_F = 0$
V_{CBO}	Collector-Base Voltage	50			V	$I_C = 100\ \mu A$, $I_F = 0$
I_{CEO}	Collector-Emitter Leakage Current			100	nA	$V_{CE} = 10$ V, $I_F = 0$
I_{CBO}	Collector-Base Leakage Current			100	nA	$V_{CB} = 10$ V, $I_F = 0$
h_{FE}	Forward Current Gain	50	250			$V_{CE} = 5.0$ V, $I_C = 100\ \mu A$
C_{cb}	Collector-Base Capacitance		20		pF	$V_{CB} = 10$ V
C_{eb}	Emitter-Base Capacitance		10		pF	$V_{EB} = 0$

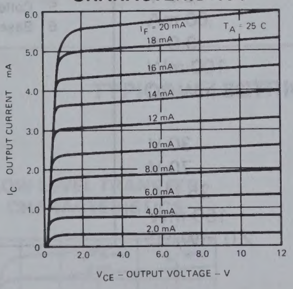
ELECTRICAL CHARACTERISTICS – COUPLED: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{IO}	Input-to-Output Voltage					
	FCD810	1500			V_{rms}	
	FCD810C	5000			V_{pk}	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage		0.3	0.7	V	$I_C = 2.6$ mA, $I_F = 50$ mA
I_C/I_F(CTR)	Collector Current Transfer Ratio (Note 1)	10	25		%	$V_{CE} = 10$ V, $I_F = 10$ mA
R_{IO}	Input-to-Output Resistance	10^{11}			Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		1.0		pF	f = 1.0 MHz
t_r, t_f	Collector Rise and Fall Times (Note 2)		4.0		μs	$I_C = 2.0$ mA, $V_{CE} = 10$ V, $R_L = 100\ \Omega$

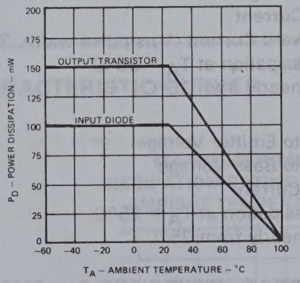
NOTES:
1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

LOW LEVEL TRANSFER CHARACTERISTICS



MAXIMUM POWER DISSIPATION RATING VERSUS AMBIENT TEMPERATURE



FCD820 • FCD820C

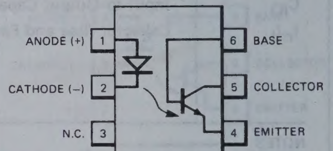
OPTICALLY-COUPLED ISOLATOR

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The FCD820 series of optoisolators combines a gallium arsenide infrared emitting diode and a silicon npn phototransistor in close proximity. Optical intercoupling provides a high degree of ac and dc isolation. A capability for continuous operation of the input diode results in a frequency response extending to dc. Connection to the transistor base is also provided for design flexibility. The FCD820 is covered under U.L. component recognition program, reference file E55299.

- **GLASSOLATED™**
- **HIGH CURRENT TRANSFER RATIO – TYPICALLY 50%**
- **1500 V TO 6000 V MINIMUM ISOLATION INPUT-TO-OUTPUT**
- **10^{11} Ω ISOLATION RESISTANCE**
- **LOW COUPLING CAPACITANCE – TYPICALLY 1.0 pF**

CONNECTION DIAGRAM
DIP (TOP VIEW)



PIN NUMBERS

1	Anode (+)	Input Diode
2	Cathode (–)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

ABSOLUTE MAXIMUM RATINGS

Storage Temperature		−55°C to +150°C
Operating Temperature		−55°C to +100°C
Pin Temperature (Soldering, 5 s)		260°C
Total Package Power Dissipation at T_A = 25°C (LED plus Detector)		250 mW
Derate Linearly from 25°C		3.3 mW/°C
INPUT DIODE		
V_R	Reverse Voltage	3.0 V
I_F	Forward Current	60 mA
i_f	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at T_A = 25°C	100 mW
	Derate Linearly from 25°C	1.33 mW/°C
OUTPUT TRANSISTOR		
V_{CE}	Collector to Emitter Voltage	30 V
V_{CB}	Collector to Base Voltage	70 V
I_C	Collector Current	25 mA
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

ELECTRICAL CHARACTERISTICS – INPUT DIODE: T_A = 25°C

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.2	1.5	V	I_F = 60 mA
BV_R	Reverse Breakdown Voltage	3.0	8.0		V	I_R = 10 μA

ELECTRICAL CHARACTERISTICS – OUTPUT TRANSISTOR: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{CEO}	Collector-Emitter Voltage	30	65		V	$I_C = 1.0$ mA, $I_F = 0$
V_{CBO}	Collector-Base Voltage	70	165		V	$I_C = 100\ \mu A$, $I_F = 0$
I_{CEO}	Collector-Emitter Leakage Current			50	nA	$V_{CE} = 10$ V, $I_F = 0$
I_{CBO}	Collector-Base Leakage Current			20	nA	$V_{CB} = 10$ V, $I_F = 0$
h_{FE}	Forward Current Gain	100	250			$V_{CE} = 5.0$ V, $I_C = 100\ \mu A$
C_{cb}	Collector-Base Capacitance		20		pF	$V_{CB} = 10$ V
C_{eb}	Emitter-Base Capacitance		10		pF	$V_{EB} = 0$

ELECTRICAL CHARACTERISTICS – COUPLED: $T_A = 25°C$

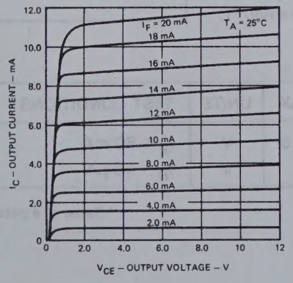
SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{IO}	Input-to-Output Voltage					
	FCD820	1500			V_{rms}	
	FCD820C	5000			V_{pk}	
$V_{CE(SAT)}$	Collector-Emitter Saturation Voltage		0.24	0.40	V	$I_C = 2.2$ mA, $I_F = 15$ mA (FCD820, $I_C = 2.0$ mA, $I_F = 10$ mA)
I_C/I_F(CTR)	Collector Current Transfer Ratio (Note 1)	20	50		%	$V_{CE} = 10$ V, $I_F = 10$ mA (FCD820, $V_{CE} = 0.4$ V)
R_{IO}	Input-to-Output Resistance	10^{11}			Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		1.0		pF	f = 1.0 MHz
t_r, t_f	Collector Rise and Fall Times (Note 2)		2.5		μs	$I_C = 2.0$ mA, $V_{CE} = 10$ V, $R_L = 100\ \Omega$

NOTES:

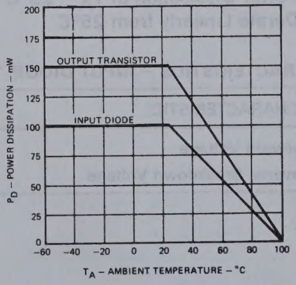
1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

LOW LEVEL TRANSFER CHARACTERISTICS



MAXIMUM POWER DISSIPATION RATING VERSUS AMBIENT TEMPERATURE



FCD825 • FCD825C

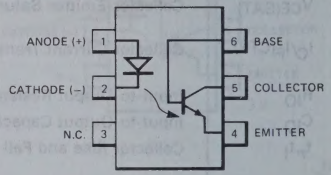
OPTICALLY – COUPLED ISOLATOR

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The FCD825 series of optoisolators have a npn silicon Planar* phototransistor and a gallium arsenide diode in close proximity. Optical intercoupling provides a high degree of ac and dc isolation. A capability for continuous operation of the input diode results in a frequency response extending to dc. Connection to the transistor base is also provided for design flexibility.

- GLASSOLATED™
- HIGH CURRENT TRANSFER RATIO – TYPICALLY 80%
- 1500 V TO 6000 V MINIMUM ISOLATION INPUT-TO-OUTPUT
- 10^{11} Ω ISOLATION RESISTANCE
- LOW COUPLING CAPACITANCE – TYPICALLY 1.0 pF

CONNECTION DIAGRAM
DIP (TOP VIEW)



PIN NUMBERS

1	Anode (+)	Input Diode
2	Cathode (–)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

ABSOLUTE MAXIMUM RATINGS

Storage Temperature	–55°C to +150°C
Operating Temperature	–55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Total Package Power Dissipation at T_A = 25°C (LED plus Detector)	250 mW
Derate Linearly from 25°C	3.3 mW/°C

INPUT DIODE

V_R	Reverse Voltage	3.0 V
I_F	Forward Current	60 mA
i_f	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at T_A = 25°C	100 mW
	Derate Linearly from 25°C	1.33 mW/°C

OUTPUT TRANSISTOR

V_{CE}	Collector to Emitter Voltage	30 V
V_{CB}	Collector to Base Voltage	70 V
I_C	Collector Current	25 mA
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

ELECTRICAL CHARACTERISTICS – **INPUT DIODE:** T_A = 25°C

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.3	1.5	V	I_F = 60 mA
BV_R	Reverse Breakdown Voltage	3.0	8.0		V	I_R = 10 μA

*Planar is a patented Fairchild process.

ELECTRICAL CHARACTERISTICS – OUTPUT TRANSISTOR: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{CEO}	Collector-Emitter Voltage	30	50		V	$I_C = 1.0$ mA, $I_F = 0$
V_{CBO}	Collector-Base Voltage	70	150		V	$I_C = 10\ \mu A$, $I_F = 0$
I_{CEO}	Collector-Emitter Leakage Current		2.0	50	nA	$V_{CE} = 10$ V, $I_F = 0$
I_{CBO}	Collector-Base Leakage Current			20	nA	$V_{CB} = 10$ V, $I_F = 0$
h_{FE}	Forward Current Gain	100	350			$V_{CE} = 5.0$ V, $I_C = 100\ \mu A$
C_{cb}	Collector-Base Capacitance		20		pF	$V_{CB} = 10$ V
C_{eb}	Emitter-Base Capacitance		10		pF	$V_{EB} = 0$

ELECTRICAL CHARACTERISTICS – COUPLED: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{IO}	Input-to-Output Voltage					
	FCD825	1500			V_{rms}	
	FCD825C	5000			V_{pk}	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage		0.24	0.4	V	$I_C = 2.0$ mA, $I_F = 10$ mA
I_C/I_F(CTR)	Collector Current Transfer Ratio (Note 1)	50	80		%	$V_{CE} = 10$ V, $I_F = 10$ mA
R_{IO}	Input-to-Output Resistance	10^{11}			Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		1.0		pF	f = 1.0 MHz
t_r, t_f	Collector Rise and Fall Times (Note 2)		3.5		µs	$I_C = 2.0$ mA, $V_{CE} = 10$ V, $R_L = 100\ \Omega$

NOTES:
1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

FCD830 • FCD830C

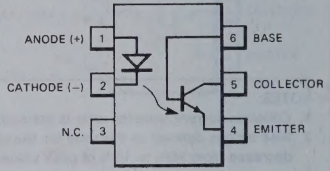
OPTICALLY - COUPLED ISOLATOR

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The FCD830 series of optoisolators have a npn silicon Planar* phototransistor in close proximity with a gallium arsenide diode. Optical coupling provides a high degree of ac and dc isolation. A capability for continuous operation of the input diode results in a frequency response extending to dc. Connection to the transistor base is also provided for design flexibility.

- **GLASSOLATED™**
- **HIGH CURRENT TRANSFER RATIO – TYPICALLY 50%**
- **1500 V TO 6000 V MINIMUM ISOLATION INPUT-TO-OUTPUT**
- **10^{11} ISOLATION RESISTANCE**
- **LOW COUPLING CAPACITANCE – TYPICALLY 1.0 pF**
- **HIGH SPEED**

CONNECTION DIAGRAM
DIP (TOP VIEW)



PIN NUMBERS

1	Anode (+)	Input Diode
2	Cathode (–)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

ABSOLUTE MAXIMUM RATINGS

Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Total Package Power Dissipation at T_A = 25°C (LED plus Detector)	250 mW
Derate Linearly from 25°C	3.3 mW/°C

INPUT DIODE

V_R	Reverse Voltage	3.0 V
I_F	Forward Current	60 mA
i_f	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at T_A = 25°C	100 mW
	Derate Linearly from 25°C	1.33 mW/°C

OUTPUT TRANSISTOR

V_{CE}	Collector to Emitter Voltage	30 V
V_{CB}	Collector to Base Voltage	70 V
I_C	Collector Current	20 mA
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.6 mW/°C

ELECTRICAL CHARACTERISTICS – INPUT DIODE: T_A = 25°C

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.3	1.5	V	I_F = 60 mA
BV_R	Reverse Breakdown Voltage	3.0	8.0		V	I_R = 10 μA

*Planar is a patented Fairchild process.

ELECTRICAL CHARACTERISTICS – OUTPUT TRANSISTOR: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{CEO}	Collector-Emitter Voltage	30	65		V	$I_C = 1.0$ mA, $I_F = 0$
V_{CBO}	Collector-Base Voltage	70	165		V	$I_C = 10\ \mu A$, $I_F = 0$
I_{CEO}	Collector-Emitter Leakage Current		2.0	50	nA	$V_{CE} = 10$ V, $I_F = 0$
I_{CBO}	Collector-Base Leakage Current		0.1	20	nA	$V_{CB} = 10$ V, $I_F = 0$
h_{FE}	Forward Current Gain	100				$V_{CE} = 5.0$ V, $I_C = 100\ \mu A$
C_{cb}	Collector-Base Capacitance		7.5		pF	$V_{CB} = 10$ V
C_{eb}	Emitter-Base Capacitance		10		pF	$V_{EB} = 0$

ELECTRICAL CHARACTERISTICS – COUPLED: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{IO}	Input-to-Output Voltage					
	FCD830	1500			V_{rms}	
	FCD830C	5000			V_{pk}	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage		0.24	0.40	V	$I_C = 2.2$ mA, $I_F = 15$ mA (FCD830, $I_C = 2.0$ mA, $I_F = 10$ mA)
I_C/I_F (CTR)	Collector Current Transfer Ratio (Note 1)	20	50		%	$V_{CE} = 10$ V, $I_F = 10$ mA (FCD830, $V_{CE} = 0.4$ V)
R_{IO}	Input-to-Output Resistance	10^{11}			Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		1.0		pF	f = 1.0 MHz
t_r, t_f	Collector Rise and Fall Times (Note 2)		1.6	2.0	µs	$I_C = 2.0$ mA, $V_{CC} = 10$ V, $R_L = 100\ \Omega$

NOTES:

1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

FCD831 • FCD831C

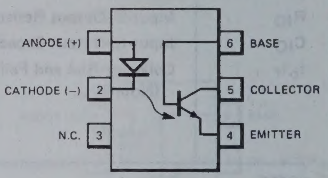
OPTICALLY — COUPLED ISOLATOR

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The FCD831 series of optoisolators combines a gallium arsenide infrared emitting diode and a silicon npn phototransistor in close proximity. Optical intercoupling provides a high degree of ac and dc isolation. A capability for continuous operation of the input diode results in a frequency response extending to dc. Connection to the transistor base is also provided for design flexibility.

- **GLASSOLATED™**
- **1500 V TO 6000 V MINIMUM ISOLATION INPUT-TO-OUTPUT**
- **10^{11} Ω ISOLATION RESISTANCE**
- **LOW COUPLING CAPACITANCE – TYPICALLY 1.0 pF**
- **HIGH SPEED**

CONNECTION DIAGRAM
DIP (TOP VIEW)



PIN NUMBERS

1	Anode (+)	Input Diode
2	Cathode (–)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

ABSOLUTE MAXIMUM RATINGS

Storage Temperature		–55°C to +150°C
Operating Temperature		–55°C to +100°C
Pin Temperature (Soldering, 5 s)		260°C
Total Package Power Dissipation at $T_A = 25°C$ (LED plus Detector)		250 mW
Derate Linearly from 25°C		3.3 mW/°C
INPUT DIODE		
V_R	Reverse Voltage	3.0 V
I_F	Forward Current	60 mA
i_f	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at $T_A = 25°C$	100 mW
	Derate Linearly from 25°C	1.33 mW/°C
OUTPUT TRANSISTOR		
V_{CE}	Collector to Emitter Voltage	30 V
V_{CB}	Collector to Base Voltage	70 V
I_C	Collector Current	20 mA
P_D	Power Dissipation at $T_A = 25°C$	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

ELECTRICAL CHARACTERISTICS – INPUT DIODE: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.3	1.5	V	$I_F = 60$ mA
BV_R	Reverse Breakdown Voltage	3.0	8.0		V	$I_R = 10$ μA

ELECTRICAL CHARACTERISTICS – OUTPUT TRANSISTOR: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{CEO}	Collector-Emitter Voltage	30	65		V	$I_C = 1.0$ mA, $I_F = 0$
V_{CBO}	Collector-Base Voltage	70	165		V	$I_C = 10\ \mu A$, $I_F = 0$
I_{CEO}	Collector-Emitter Leakage Current		2.0		nA	$V_{CE} = 10$ V, $I_F = 0$
I_{CBO}	Collector-Base Leakage Current		0.1	50	nA	$V_{CB} = 10$ V, $I_F = 0$
h_{FE}	Forward Current Gain		250	20		$V_{CE} = 5.0$ V, $I_C = 100\ \mu A$
C_{cb}	Collector-Base Capacitance	100	7.5		pF	$V_{CB} = 10$ V
C_{eb}	Emitter-Base Capacitance		10		pF	$V_{EB} = 0$

ELECTRICAL CHARACTERISTICS – COUPLED: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{IO}	Input-to-Output Voltage					
	FCD831	1500			V_{rms}	
	FCD831C	5000			V_{pk}	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage		0.30	0.5	V	$I_C = 2.0$ mA, $I_F = 50$ mA
I_C/I_F(CTR)	Collector Current Transfer Ratio (Note 1)	10	15		%	$V_{CE} = 10$ V, $I_F = 10$ mA
R_{IO}	Input-to-Output Resistance	10^{11}			Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		1.0		pF	f = 1.0 MHz
t_r, t_f	Collector Rise and Fall Times (Note 2)		1.6	2.0	μs	$I_C = 2.0$ mA, $V_{CE} = 10$ V, $R_L = 100\ \Omega$

NOTES:
1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

FCD836 • FCD836C

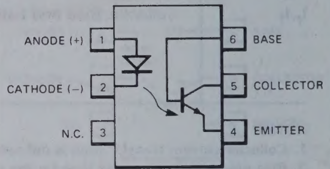
OPTICALLY-COUPLED ISOLATOR

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The FCD836 series of optoisolators combines a gallium arsenide infrared emitting diode and a silicon npn phototransistor in close proximity. Optical intercoupling provides a high degree of ac and dc isolation. A capability for continuous operation of the input diode results in a frequency response extending to dc. Connection to the transistor base is also provided for design flexibility.

- **GLASSOLATED™**
- **1500 V TO 6000 V MINIMUM ISOLATION INPUT-TO-OUTPUT**
- **10^{11} Ω ISOLATION RESISTANCE**
- **LOW COUPLING CAPACITANCE – TYPICALLY 1.0 pF**
- **HIGH SPEED**

CONNECTION DIAGRAM
DIP (TOP VIEW)



PIN NUMBERS

1	Anode (+)	Input Diode
2	Cathode (–)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

ABSOLUTE MAXIMUM RATINGS

Storage Temperature		−55°C to +150°C
Operating Temperature		−55°C to +100°C
Pin Temperature (Soldering, 5 s)		260°C
Total Package Power Dissipation at T_A = 25°C (LED plus Detector)		250 mW
Derate Linearly from 25°C		3.3 mW/°C
INPUT DIODE		
V_R	Reverse Voltage	3.0 V
I_F	Forward Current	60 mA
i_f	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at T_A = 25°C	100 mW
	Derate Linearly from 25°C	1.33 mW/°C
OUTPUT TRANSISTOR		
V_{CE}	Collector to Emitter Voltage	20 V
V_{CB}	Collector to Base Voltage	30 V
I_C	Collector Current	20 mA
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

ELECTRICAL CHARACTERISTICS – INPUT DIODE: T_A = 25°C

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.3	1.5	V	I_F = 10 mA
BV_R	Reverse Breakdown Voltage	3.0	8.0		V	I_R = 10 μA

ELECTRICAL CHARACTERISTICS – OUTPUT TRANSISTOR: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{CEO}	Collector-Emitter Voltage	20	50		V	$I_C = 1.0$ mA, $I_F = 0$
V_{CBO}	Collector-Base Voltage	30	60		V	$I_C = 10\ \mu A$, $I_F = 0$
I_{CEO}	Collector-Emitter Leakage Current		2.0	100	nA	$V_{CE} = 10$ V, $I_F = 0$
I_{CBO}	Collector-Base Leakage Current		0.1	20	nA	$V_{CB} = 10$ V, $I_F = 0$
h_{FE}	Forward Current Gain	50	250			$V_{CE} = 5.0$ V, $I_C = 100\ \mu A$
C_{cb}	Collector-Base Capacitance		7.5		pF	$V_{CB} = 10$ V
C_{eb}	Emitter-Base Capacitance		10		pF	$V_{EB} = 0$

ELECTRICAL CHARACTERISTICS – COUPLED: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{IO}	Input-to-Output Voltage					
	FCD836	1500			V_{rms}	
	FCD836C	5000			V_{pk}	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage		0.35	0.7	V	$I_C = 2.0$ mA, $I_F = 50$ mA
I_C/I_F(CTR)	Collector Current Transfer Ratio (Note 1)	6.0	10		%	$V_{CE} = 10$ V, $I_F = 10$ mA
R_{IO}	Input-to-Output Resistance	10^{11}			Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		1.0		pF	f = 1.0 MHz
t_r, t_f	Collector Rise and Fall Times (Note 2)		1.6	2.0	µs	$I_C = 2.0$ mA, $V_{CE} = 10$ V, $R_L = 100\ \Omega$

NOTES:

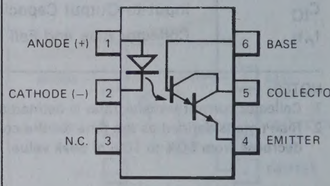
1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

FCD850 · FCD850C
FCD855 · FCD855C
OPTICALLY – COUPLED DARLINGTON ISOLATOR
OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION — The FCD850, FCD855 series of optoisolators have a npn silicon Planar* Darlington phototransistor coupled to a gallium arsenide diode. Each is mounted in a 6-pin plastic dual in-line package. The FCD850/FCD850C has a minimum collector-emitter breakdown voltage of 30 V; the FCD855/FCD855C has a minimum collector-emitter breakdown voltage of 55 V.

- **GLASSOLATED™**
- **HIGH CURRENT TRANSFER RATIO**
- **5000 V TO 6000 V MINIMUM ISOLATION INPUT-TO-OUTPUT**
- **10^{11} Ω ISOLATION RESISTANCE**
- **LOW COUPLING CAPACITANCE – TYPICALLY 1.0 pF**

CONNECTION DIAGRAM
DIP (TOP VIEW)



PIN NUMBERS

1	Anode (+)	Input Diode
2	Cathode (–)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

ABSOLUTE MAXIMUM RATINGS

Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 10 s)	260°C
Total Package Power Dissipation at $T_A = 25°C$ (LED plus Detector)	250 mW
Derate Linearly from 25°C	3.3 mW/°C

INPUT DIODE

V_R	Reverse Voltage	3.0 V
I_F	Forward Current	60 mA
i_f	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at $T_A = 25°C$	150 mW
	Derate Linearly from 25°C	1.33 mW/°C

OUTPUT TRANSISTOR (DARLINGTON)		FCD850	FCD855
V_{CE}	Collector to Emitter Voltage	30 V	55 V
V_{CB}	Collector to Base Voltage	30 V	55 V
V_{EC}	Emitter to Collector Voltage	7.0 V	7.0 V
I_C	Collector Current	125 mA	125 mA
P_D	Power Dissipation at $T_A = 25°C$	150 mW	150 mW
	Derate Linearly from 25°C	2.0 mW/°C	2.0 mW/°C

ELECTRICAL CHARACTERISTICS – INPUT DIODE: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.25	1.5	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	3.0	5.0		V	$I_R = 10$ μA
C	Capacitance		150		pF	$V_R = 0$ V, f = 1 MHz

*Planar is a patented Fairchild process.

ELECTRICAL CHARACTERISTICS – OUTPUT TRANSISTOR: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{CEO}	Collector-Emitter Voltage					
	FCD850, FCD850C	30			V	$I_C = 100\ \mu A$, $I_F = 0$
	FCD855, FCD855C	55			V	$I_C = 100\ \mu A$, $I_F = 0$
V_{ECO}	Emitter-Collector Voltage	7.0			V	$I_E = 100\ \mu A$, $I_F = 0$
V_{EBO}	Emitter-Base Voltage	8.0			V	$I_E = 100\ \mu A$, $I_F = 0$
I_{CEO}	Collector-Emitter Leakage Current			100	nA	$V_{CE} = 10$ V, $I_F = 0$
h_{FE}	Forward Current Gain		7000			$V_{CE} = 5.0$ V, $I_C = 25$ mA
C_{cb}	Collector-Base Capacitance		25		pF	$V_{CB} = 10$ V

ELECTRICAL CHARACTERISTICS – COUPLED: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{IO}	Input-to-Output Voltage (Note 1)					
	FCD850, FCD855	1500			V_{rms}	
	FCD850C, FCD855C	5000			V_{pk}	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage			1.0	V	$I_C = 50$ mA, $I_F = 50$ mA
I_C	Collector Output Current	10	150		mA	$V_{CE} = 5.0$ V, $I_F = 10$ mA
R_{IO}	Input-to-Output Resistance		10^{11}		Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		1.5		pF	$V_{IO} = 0$, f = 1.0 MHz
t_r	Rise Time (Note 2)		15		μs	$I_C = 125$ mA, $V_{CC} = 13.5$ V, $R_L = 100\ \Omega$
t_f	Fall Time (Note 2)		150		μs	$I_C = 125$ mA, $V_{CC} = 13.5$ V, $R_L = 100\ \Omega$

NOTES:

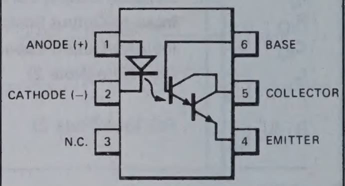
1. Isolation voltage defined as min of 5 seconds continuous application.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

FCD860 · FCD860C
FCD865 · FCD865C
OPTICALLY-COUPLED DARLINGTON ISOLATOR
OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The FCD860, FCD865 series of optoisolators have a npn silicon Planar* Darlington phototransistor coupled to a gallium arsenide diode. Each is mounted in a 6-pin plastic dual in-line package. The series was designed specifically as a high sensitivity type for operation in the 1.0 mA input region.

- **GLASSOLATED™**
- **HIGH CURRENT TRANSFER RATIO AT LOW INPUT CURRENT**
- **5000 V TO 6000 V MINIMUM ISOLATION INPUT-TO-OUTPUT**
- **10^{11} Ω ISOLATION RESISTANCE**
- **LOW COUPLING CAPACITANCE – TYPICALLY 1.5 pF**

CONNECTION DIAGRAM
DIP (TOP VIEW)



PIN NUMBERS

1	Anode (+)	Input Diode
2	Cathode (–)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

ABSOLUTE MAXIMUM RATINGS

Storage Temperature		–55°C to +150°C
Operating Temperature		–55°C to +100°C
Pin Temperature (Soldering, 10 s)		260°C
Total Package Power Dissipation at T_A = 25°C (LED plus Detector)		250 mW
Derate Linearly from 25°C		3.3 mW/°C
INPUT DIODE		
V_R	Reverse Voltage	3.0 V
I_F	Forward Current	80 mA
i_f	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C
OUTPUT TRANSISTOR (DARLINGTON)		
V_{CE}	Collector to Emitter Voltage	30 V
V_{CB}	Collector to Base Voltage	30 V
V_{EC}	Emitter to Collector Voltage	7.0 V
P_D	Power Dissipation at T_A = 25°C (I_C max 100 mA at V_{CE} = 1.5 V)	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

ELECTRICAL CHARACTERISTICS – **INPUT DIODE:** T_A = 25°C

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.25	1.5	V	I_F = 20 mA
BV_R	Reverse Breakdown Voltage	3.0	5.0		V	I_R = 10 μA
C	Capacitance		150		pF	V_R = 0 V, f = 1 MHz

*Planar is a patented Fairchild process.

ELECTRICAL CHARACTERISTICS – OUTPUT TRANSISTOR: $T_A = 25°C$ (DARLINGTON)

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{CEO}	Collector-Emitter Voltage	30			V	$I_C = 1.0$ mA, $I_F = 0$
V_{CBO}	Collector-Base Voltage	30			V	$I_C = 10\ \mu A$, $I_F = 0$
V_{ECO}	Emitter-Collector Voltage	7.0			V	$I_E = 100\ \mu A$, $I_F = 0$
V_{EBO}	Emitter-Base Voltage	6.0	8.0		V	$I_E = 100\ \mu A$, $I_F = 0$
I_{CEO}	Collector-Emitter Leakage Current			100	nA	$V_{CE} = 10$ V, $I_F = 0$
h_{FE}	Forward Current Gain		20k			$V_{CE} = 5.0$ V, $I_C = 25$ mA

ELECTRICAL CHARACTERISTICS – COUPLED: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{IO}	Input-to-Output Voltage (Note 1)					
	FCD860, FCD865	1500			V_{rms}	
	FCD860C, FCD865C	5000			V_{pk}	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage			1.0	V	$I_C = 2.0$ mA, $I_F = 1.0$ mA
I_C	Collector Output Current					
	FCD860, FCD860C	2.0			mA	$V_{CE} = 1.0$ V, $I_F = 1.0$ mA
	FCD865, FCD865C	2.0			mA	$V_{CE} = 1.0$ V, $I_F = 0.5$ mA
R_{IO}	Input-to-Output Resistance		10^{11}		Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		1.5		pF	$V_{IO} = 0$, $f = 1.0$ MHz
t_r, t_f	Rise and Fall Times (Note 2)		80		μs	$I_C = 10$ mA, $V_{CC} = 10$ V, $R_L = 100\ \Omega$

NOTES:

1. Isolation voltage defined as min of 5 seconds continuous application.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

FCD880 • FCD885

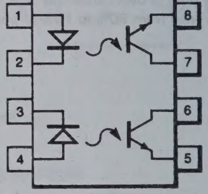
DUAL OPTICALLY-COUPLED ISOLATOR

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION — The FCD 880 and FCD 885 comprise two distinct optoisolators with transistor output, in a single 8-pin dual in-line package. Each channel consists of a gallium arsenide emitter optically coupled to a photo-transistor.

- **HIGH CURRENT TRANSFER RATIO**
- **2500 V MINIMUM ISOLATION INPUT-TO-OUTPUT**
- **10^{11} Ω ISOLATION RESISTANCE**
- **LOW COUPLING CAPACITANCE — TYPICALLY 1.0 pF**
- **I/O COMPATIBLE WITH INTEGRATED CIRCUITS**
- **TWO PACKAGES FITS INTO A STANDARD 16-PIN DIP SOCKET**

CONNECTION DIAGRAM
DIP (TOP VIEW)



PIN NUMBER	
1 ANODE	**CHANNEL #1**
2 CATHODE	
3 CATHODE	**CHANNEL #2**
4 ANODE	
5 EMITTER	**CHANNEL #1**
6 COLLECTOR	
7 COLLECTOR	**CHANNEL #2**
8 EMITTER	

ABSOLUTE MAXIMUM RATINGS

Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Total Package Power Dissipation at T_A = 25°C	400 mW
Derate Linearly from 25°C	5.3 mW/°C

INPUT DIODE (EACH CHANNEL)

V_R	Reverse Voltage	3.0V
I_F	Forward Current	60 mA
i_f	Peak Forward Current (1 μs pulse, 300 pps)	3.0 A
P_D	Power Dissipation at T_A = 25°C	100 mW
	Derate Linearly from 50°C	2 mW/°C

OUTPUT TRANSISTOR (EACH CHANNEL)

V_{CE}	Collector to Emitter Voltage	30 V
V_{ECO}	Emitter to Collector Voltage	6.0 V
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2 mW/°C
I_C	Collector Current	30 mA

ELECTRICAL CHARACTERISTICS — INPUT DIODE: T_A = 25°C

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.25	1.5	V	I_F = 60 mA
V_R	Reverse Voltge	3.0	5.5		V	I_R = 10 μA
C_J	Junction Capacitance		100		pF	V_F = 0 V

ELECTRICAL CHARACTERISTICS — OUTPUT TRANSISTOR: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	FCD880			FCD885			UNITS	TEST CONDITIONS
		MIN	TYP	MAX	MIN	TYP	MAX		
V_{CEO}	Collector-Emitter Voltage	30	65		30	65		V	$I_C = 1.0$ mA, $I_F = 0$
V_{ECO}	Emitter-Collector Voltage	6.0	10		6.0	10		V	$I_C = 100\ \mu A$
I_{CEO}	Collector-Emitter Leakage Current		5.0	100		5.0	100	nA	$V_{CE} = 10$ V, $I_F = 0$
C_{CE}	Collector-Emitter Capacitance		8.0			8.0		pF	$V_{CE} = 0$

ELECTRICAL CHARACERISTICS — COUPLED: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{IO}	Input-to-Output Voltage	2500	4000		V	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage					
	FDC880		0.24	0.4	V	$I_C = 2.0$ mA, $I_F = 16$ mA
	FCD885		0.2	0.3	V	$I_C = 250\ \mu A$, $I_F = 20$ mA
I_C/I_F(CTR)	Collector Current Transfer Ratio (Note 1)					
	FCD880	30	50		%	$V_{CE} = 10$ V, $I_F = 10$ mA
	FCD885	10	20		%	$V_{CE} = 10$ V, $I_F = 10$ mA
R_{IO}	Input-to-Output Resistance		10^{11}		Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		1.0		pF	f = 1.0 MHz
t_r, t_f	Collector Rise and Fall Times (Note 2)		2.0		μs	$I_C = 2.0$ mA, $V_{CE} = 10$ V, $R_L = 100\ \Omega$

NOTES:

1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

H11A1 • H11A2 • H11A3 • H11A4

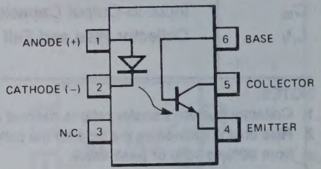
OPTICALLY-COUPLED ISOLATOR

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The H11A1, H11A2, H11A3 and H11A4 optical isolators are electrical and mechanical replacements for the General Electric series. Optical intercoupling provides a high degree of ac and dc isolation. A capability for continuous operation of the input diode results in a frequency response extending to dc. Connection to the base is also provided for design flexibility.

- **GLASSOLATED™**
- **ELECTRICALLY EQUIVALENT TO GE DEVICES**
- **PIN-FOR-PIN EQUIVALENT TO GE DEVICES**
- **AVAILABILITY OF BASE PIN FOR FLEXIBLE DESIGN**

CONNECTION DIAGRAM
DIP (TOP VIEW)



PIN NUMBERS

1	Anode (+)	Input Diode
2	Cathode (–)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

ABSOLUTE MAXIMUM RATINGS

Storage Temperature		−55°C to +150°C
Operating Temperature		−55°C to +100°C
Pin Temperature (Soldering, 5 s)		260°C
Total Package Power Dissipation at T_A = 25°C (LED plus Detector)		250 mW
Derate Linearly from 25°C		3.3 mW/°C
INPUT DIODE		
V_R	Reverse Voltage	3.0 V
I_F	Forward Current	60 mA
i_f	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at T_A = 25°C	100 mW
	Derate Linearly from 25°C	1.33 mW/°C
OUTPUT TRANSISTOR		
V_{CE}	Collector to Emitter Voltage	30 V
V_{CB}	Collector to Base Voltage	70 V
I_C	Collector Current	100 mA
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

ELECTRICAL CHARACTERISTICS – INPUT DIODE: T_A = 25°C

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.1	1.5	V	I_F = 10 mA
I_R	Reverse Current			10	μA	V_R = 3.0 V

ELECTRICAL CHARACTERISTICS – OUTPUT TRANSISTOR: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{CEO}	Collector-Emitter Voltage	30			V	$I_C = 10$ mA, $I_F = 0$
V_{CBO}	Collector-Base Voltage	70			V	$I_C = 100\ \mu A$, $I_F = 0$
V_{ECO}	Emitter-Collector Voltage	7.0			V	$I_E = 100\ \mu A$, $I_F = 0$
I_{CEO}	Collector-Emitter Leakage Current		5.0	50	nA	$V_{CE} = 10$ V, $I_F = 0$

ELECTRICAL CHARACTERISTICS – COUPLED: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{ISO}	Isolation Voltage (Note-3)					
	H11A1, H11A3	2500			V	Peak
	H11A2, H11A4	1500			V	Peak
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage		0.1	0.4	V	$I_C = 0.5$ mA, $I_F = 50$ mA
I_C/I_F(CTR)	Collector Current Transfer Ratio (Note 1)					$V_{CE} = 10$ V, $I_F = 10$ mA
	H11A1	50			%	
	H11A2, H11A3	20			%	
	H11A4	10			%	
R_{IO}	Input-to-Output Resistance	10^{11}			Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		2.0		pF	f = 1.0 MHz
t_r, t_f	Collector Rise and Fall Times (Note 2)		2.0		μs	$I_C = 2.0$ mA, $V_{CE} = 10$ V, $R_L = 100\ \Omega$

NOTES:

1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.
3. Isolation voltage defined as min. of 5 sec. continuous application.

H11B1 • H11B2

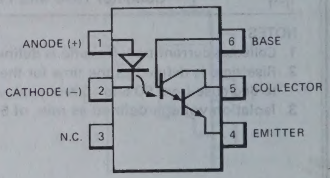
OPTICALLY-COUPLED DARLINGTON ISOLATOR

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The H11B1 and H11B2 optical isolators are electrical and mechanical replacements for the General Electric series. Optical intercoupling provides a high degree of ac and dc isolation. A capability for continuous operation of the input diode results in a frequency response extending to dc. Connection to the base is also provided for design flexibility.

- **GLASSOLATED™**
- **ELECTRICALLY EQUIVALENT TO GE DEVICES**
- **PIN-FOR-PIN EQUIVALENT TO GE DEVICES**
- **AVAILABILITY OF BASE PIN FOR FLEXIBLE DESIGN**

CONNECTION DIAGRAM
DIP (TOP VIEW)



PIN NUMBERS
1 Anode (+) } Input Diode
2 Cathode (–)
3 NC
4 Emitter } Output npn Phototransistor
5 Collector
6 Base

ABSOLUTE MAXIMUM RATINGS

Storage Temperature		−55°C to +150°C
Operating Temperature		−55°C to +100°C
Pin Temperature (Soldering, 10 s)		260°C
Total Package Power Dissipation at T_A = 25°C (LED plus Detector)		250 mW
Derate Linearly from 25°C		3.3 mW/°C
INPUT DIODE		
I_F	Forward dc Current Continuous	60 mA
V_R	Reverse Voltage	3.0 V
i_f	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at T_A = 25°C	100 mW
	Derate Linearly from 25°C	1.33 mW/°C
OUTPUT TRANSISTOR (DARLINGTON)		
V_{CEO}	Collector to Emitter Voltage	25 V
V_{CBO}	Collector to Base Voltage	30 V
V_{ECO}	Emitter to Collector Voltage	7.0 V
P_D	Power Dissipation at T_A = 25°C (Max I_C 100 mA at V_{CE} = 1.5 V)	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

ELECTRICAL CHARACTERISTICS – **INPUT DIODE**: T_A = 25°C

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.2	1.5	V	I_F = 10 mA
I_R	Reverse Current			10	μA	V_R = 3.0 V
C	Capacitance		150		pF	V_R = 0 V, f = 1 MHz

ELECTRICAL CHARACTERISTICS – OUTPUT TRANSISTOR (DARLINGTON): $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector-Emitter Breakdown Voltage	25			V	$I_C = 10$ mA, $I_F = 0$
BV_{ECO}	Emitter-Collector Breakdown Voltage	7.0			V	$I_E = 100$ μA, $I_F = 0$
BV_{CBO}	Collector-Base Breakdown Voltage	30			V	$I_C = 100$ μA
I_{CEO}	Collector-Emitter Leakage Current			100	nA	$V_{CE} = 10$ V, $I_F = 0$
C_{CE}	Capacitance Collector-Emitter Junction		6.0		pF	$V_{CE} = 10$ V, f = 1.0 MHz

ELECTRICAL CHARACTERISTICS – COUPLED: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
I_C	Collector Output Current (Pulsed)					
	H11B1	50			mA	$I_F = 10$ mA, $V_{CE} = 5$ V
	H11B2	20			mA	
V_{ISO}	Isolation Voltage (Note 2)					
	H11B1	2500			V	Peak
	H11B2	1500			V	Peak
R_{ISO}	Isolation Resistance		10^{11}		Ω	V = 500 V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage			1.0	V	$I_C = 1.0$ mA, $I_F = 1.0$ mA
C_{ISO}	Isolation Capacitance		2.0		pF	V = 0, f = 1.0 MHz
t_{on}	Turn-on Time (Note 1)		125		μs	$I_C = 10$ mA, $V_{CC} = 10$ V, $R_L = 100$ Ω
t_{off}	Turn-off Time		100		μs	$I_C = 10$ mA, $V_{CC} = 10$ V, $R_L = 100$ Ω

NOTES:

1. Turn-on time is defined as the time for the (base collector) current to rise from 10% to 90% of peak value. Turn-off time is defined as the time required for the current to decrease from 90% to 10% of peak value.
2. Isolation voltage defined as min of 5 seconds continuous application.

IL1 • IL12 • IL15 • IL16 • IL74

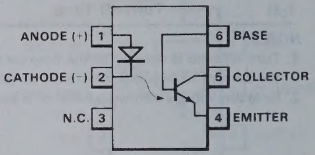
OPTICALLY-COUPLED ISOLATORS

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The IL1, IL12, IL15, IL16 and IL74 series of optically coupled isolators are electrical and mechanical replacements for the Litronix series. Optical intercoupling provides a high degree of ac and dc isolation. A capability for continuous operation of the input diode results in a frequency response extending to dc. Connection to the base is also provided for design flexibility.

- **GLASSOLATED™**
- **HIGH CURRENT TRANSFER RATIO**
- **10^{11} Ω ISOLATION RESISTANCE**
- **LOW COUPLING CAPACITANCE – TYPICALLY 1.0 pF**

CONNECTION DIAGRAM
DIP (TOP VIEW)



PIN NUMBERS

1	Anode (+)	Input Diode
2	Cathode (−)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

ABSOLUTE MAXIMUM RATINGS

Storage Temperature		−55°C to +150°C
Operating Temperature		−55°C to +100°C
Pin Temperature (Soldering, 5 s)		260°C
Total Package Power Dissipation at T_A = 25°C (LED plus Detector)		200 mW
Derate Linearly from 25°C		2.6 mW/°C
INPUT DIODE		
V_R	Reverse Voltage	3.0 V
I_F	Forward Current	60 mA
i_f	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at T_A = 25°C	100 mW
	Derate Linearly from 25°C	1.33 mW/°C
OUTPUT TRANSISTOR		
V_{CE}	Collector to Emitter Voltage	30 V
V_{CB}	Collector to Base Voltage	70 V
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

ELECTRICAL CHARACTERISTICS – INPUT DIODE: T_A = 25°C

SYMBOL	CHARACTERISTICS	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage					
	IL1, IL15, IL16		1.3	1.5	V	I_F = 60 mA
	IL12		1.3	1.5	V	I_F = 10 mA
	IL74		1.5	1.75	V	I_F = 10 mA
BV_R	Reverse Breakdown Voltage					
	IL1, IL15, IL16	3			V	I_R = 10 μA
	IL12	3			V	I_R = 100 μA

ELECTRICAL CHARACTERISTICS – OUTPUT TRANSISTOR: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{CEO}	Collector-Emitter Voltage					
	IL1, IL15, IL16	30	50		V	$I_C = 1.0$ mA, $I_F = 0$
	IL12, IL74	20	40		V	$I_C = 1.0$ mA, $I_F = 0$
V_{ECO}	Emitter-Collector Voltage					
	IL1, IL15, IL16	7.0			V	$I_E = 100$ μA, $I_F = 0$
	IL12	4.0			V	$I_E = 100$ μA, $I_F = 0$
I_{CEO}	Collector-Emitter Leakage Current					
	IL1			50	nA	$V_{CE} = 10$ V, $I_F = 0$
	IL12			250	nA	$V_{CE} = 5.0$ V, $I_F = 0$
	IL15, IL16			100	nA	$V_{CE} = 5.0$ V, $I_F = 0$
	IL74			500	nA	$V_{CE} = 5.0$ V, $I_F = 0$
h_{FE}	Forward Current Gain					
	IL12	50				$V_{CE} = 5.0$ V, $I_C = 100$ μA

ELECTRICAL CHARACTERISTICS – COUPLED: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{IO}	Input-to-Output Voltage					
	IL1	2500			V	
	IL12	1000			V	
	IL15, IL16, IL74	1500			V	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage					
	IL1			0.5	V	$I_F = 16$ mA, $I_C = 1.6$ mA
	IL15, IL16			0.5	V	$I_F = 50$ mA, $I_C = 2$ mA
	IL74			0.5	V	$I_F = 16$ mA, $I_C = 2$ mA
I_C/I_F(CTR)	Collector Current Transfer Ratio (Note 1)					
	IL1	20			%	$V_{CE} = 10$ V, $I_F = 10$ mA
	IL12	10			%	$V_{CE} = 5.0$ V, $I_F = 10$ mA
	IL15	6.0			%	$V_{CE} = 10$ V, $I_F = 10$ mA
	IL16	6.0		30	%	$V_{CE} = 10$ V, $I_F = 10$ mA
	IL74	12.5			%	$V_{CE} = 5.0$ V, $I_F = 16$ mA
C_{IO}	Input-to-Output Capacitance					
	IL12, IL15, IL16			2.0	pF	f = 1.0 MHz

NOTES: 1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.

MCA230 • MCA231 • MCA255

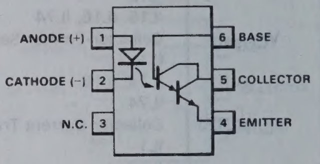
OPTICALLY-COUPLED DARLINGTON ISOLATOR

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The MCA230, MCA231 and MCA255 series of optically coupled isolators are electrical and mechanical replacements for the Monsanto series. Optical intercoupling provides a high degree of ac and dc isolation. Connection to the base is also provided for design flexibility.

- **GLASSOLATED™**
- **HIGH CURRENT TRANSFER RATIO AT LOW INPUT CURRENT**
- **10^{11} Ω ISOLATION RESISTANCE**
- **LOW COUPLING CAPACITANCE – TYPICALLY 1.5 pF**

CONNECTION DIAGRAM
DIP (TOP VIEW)



PIN NUMBERS

1 Anode (+) 2 Cathode (–)	Input Diode
3 NC	
4 Emitter 5 Collector 6 Base	Output npn Phototransistor

ABSOLUTE MAXIMUM RATINGS

Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 10 s)	260°C
Total Package Power Dissipation at T_A = 25°C (LED plus Detector)	300 mW
Derate Linearly from 25°C	4.0 mW/°C

INPUT DIODE

V_R	Reverse Voltage	3.0 V
I_F	Forward Current	60 mA
i_f	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at T_A = 25°C	90 mW
	Derate Linearly from 55°C	2.0 mW/°C

OUTPUT TRANSISTOR (DARLINGTON)		**MCA230/231**	**MCA255**
V_{CE}	Collector to Emitter Voltage	30 V	55 V
V_{CB}	Collector to Base Voltage	30 V	55 V
P_D	Power Dissipation at T_A = 25°C	210 mW	210 mW
	Derate Linearly from 25°C	2.8 mW/°C	2.8 mW/°C

ELECTRICAL CHARACTERISTICS – INPUT DIODE: T_A = 25°C

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.2	1.5	V	I_F = 20 mA
BV_R	Reverse Breakdown Voltage	3.0	5.0		V	I_R = 10 μA

ELECTRICAL CHARACTERISTICS – OUTPUT TRANSISTOR: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{CEO}	Collector-Emitter Voltage					
	MCA230/230	30			V	$I_C = 0.1$ mA, $I_F = 0$
	MCA231	30				$I_C = 1.0$ mA, $I_F = 0$
	MCA255	55				$I_C = 0.1$ mA, $I_F = 0$
V_{CBO}	Collector-Base Voltage					
	MCA230' 231	30			V	$I_C = 10$ mA, $I_F = 0$
	MCA255	55				
I_{CEO}	Collector-Emitter Leakage Current		1.0	100	nA	$V_{CE} = 10$ V, $I_F = 0$
h_{FE}	Forward Current Gain		25,000			$V_{CE} = 5.0$ V, $I_C = 500$ μA
V_{EBO}	Emitter-Base Voltage					$I_E = 10$ μA
	MCA230/255	8			V	
	MCA231	6			V	

ELECTRICAL CHARACTERISTICS – COUPLED: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
I_C	Collector Output Current					
	MCA230	10	40		mA	$V_{CE} = 5.0$ V, $I_F = 10$ mA
	MCA231	2.0	4.0		mA	$V_{CE} = 1.0$ V, $I_F = 1.0$ mA
	MCA255	10	40		mA	$V_{CE} = 5.0$ V, $I_F = 10$ mA
V_{ISO}	Isolation Voltage	1500	2000		Vdc	
R_{ISO}	Isolation Resistance		10^{11}		Ω	V = 500 V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage					
	MCA230, MCA255		0.8	1.0	V	$I_C = 50$ mA, $I_F = 50$ mA
	MCA231		0.8	1.0	V	$I_C = 2.0$ mA, $I_F = 1.0$ mA
	MCA231		0.8	1.0	V	$I_C = 2$ mA, $I_F = 1$ mA
	MCA231		0.8	1.0	V	$I_C = 10$ mA, $I_F = 5$ mA
	MCA231		0.9	1.2	V	$I_C = 40$ mA, $I_F = 10$ mA
t_{on}	Turn-on Time		40		μs	$I_C = 1.0$ mA, $V_{CC} = 10$ V, $R_L = 100$ Ω
t_{off}	Turn-off Time (See Note 1)		50		μs	

NOTES:

1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

MCT2 • MCT2E • MCT26

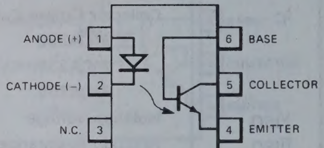
OPTICALLY-COUPLED ISOLATOR

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The MCT2, MCT2E and MCT26 optical isolators are electrical and mechanical replacements for the Monsanto series. Optical intercoupling provides a high degree of ac and dc isolation. A capability for continuous operation of the input diode results in a frequency response extending to dc. Connection to the base is also provided for design flexibility.

- **GLASSOLATED™**
- **ELECTRICALLY EQUIVALENT TO MONSANTO DEVICES**
- **PIN-FOR-PIN EQUIVALENT TO MONSANTO DEVICES**
- **AVAILABILITY OF BASE PIN FOR FLEXIBLE DESIGN**

CONNECTION DIAGRAM
DIP (TOP VIEW)



PIN NUMBERS

1 Anode (+) 2 Cathode (–)	}	Input Diode
3 NC		
4 Emitter 5 Collector 6 Base	}	Output npn Phototransistor

ABSOLUTE MAXIMUM RATINGS

Storage Temperature		–55°C to +150°C
Operating Temperature		–55°C to +100°C
Pin Temperature (Soldering, 5 s)		260°C
Total Package Power Dissipation at $T_A = 25°C$ (LED plus Detector)		250 mW
Derate Linearly from 25°C		3.3 mW/°C
INPUT DIODE		
V_R	Reverse Voltage	3.0 V
I_F	Forward Current	60 mA
i_f	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at $T_A = 25°C$	200 mW
	Derate Linearly from 25°C	2.6 mW/°C
OUTPUT TRANSISTOR		
V_{CE}	Collector to Emitter Voltage	30 V
V_{CB}	Collector to Base Voltage	30 V
V_{ECO}	Emitter to Collector Voltage	7.0 V
P_D	Power Dissipation at $T_A = 25°C$	200 mW
	Derate Linearly from 25°C	2.6 mW/°C

ELECTRICAL CHARACTERISTICS – INPUT DIODE: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.25	1.5	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	3.0	5.5		V	$I_R = 10\ \mu A$

ELECTRICAL CHARACTERISTICS – OUTPUT TRANSISTOR: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MCT2/MCT2E			MCT26			UNITS	TEST CONDITIONS
		MIN	TYP	MAX	MIN	TYP	MAX		
V_{CEO}	Collector-Emitter Voltage	30	65		30	75		V	$I_C = 1.0$ mA, $I_F = 0$
V_{CBO}	Collector-Base Voltage	70	165		30	100		V	$I_C = 100\ \mu A$
V_{ECO}	Emitter-Collector Voltage	7.0	14		7.0	12		V	$I_C = 100\ \mu A$
I_{CEO}	Collector-Emitter Leakage Current		5.0	50				nA	$V_{CE} = 10$ V, $I_F = 0$
						5.0	100	nA	$V_{CE} = 5.0$ V, $I_F = 0$
I_{CBO}	Collector-Base Leakage Current		0.1	20				nA	$V_{CB} = 10$ V, $I_F = 0$
						1.0	100	nA	$V_{CB} = 5.0$ V, $I_F = 0$
h_{FE}	Forward Current Gain	100	250		100	150			$V_{CE} = 5.0$ V, $I_C = 100\ \mu A$
C_{ce}	Collector-Emitter Capacitance		8.0			8.0		pF	$V_{CE} = 0$
C_{cb}	Collector-Base Capacitance		20					pF	$V_{CB} = 10$ V
C_{eb}	Emitter-Base Capacitance		10					pF	$V_{BE} = 0$

ELECTRICAL CHARACTERISTICS – COUPLED: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{IO}	Input-to-Output Voltage					
	MCT2	1500	2300		Vdc	f = 60 Hz
	MCT2E	2500			Vdc	
	MCT26	1500	2500		Vdc	
	MCT2	800			V_{rms}	
	MCT26	800			V_{rms}	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage					
	MCT2, MCT2E		0.24	0.4	V	$I_C = 2.0$ mA, $I_F = 16$ mA
	MCT26		0.2	0.3	V	$I_C = 250\ \mu A$, $I_F = 20$ mA
I_C/I_F(CTR)	Collector Current Transfer Ratio (Note 1)					
	MCT2, MCT2E	20	50		%	$V_{CE} = 10$ V, $I_F = 10$ mA
	MCT26	6	14		%	
R_{IO}	Input-to-Output Resistance					
	MCT2		10^{11}		Ω	$V_{IO} = 500$ V
	MCT2E		10^{11}	10^{12}	Ω	
C_{IO}	Input-to-Output Capacitance					
	MCT2, MCT2E		1.0		pF	f = 1.0 MHz
	MCT26		1.0	2.0	pF	
t_r, t_f	Collector Rise and Fall Times (Note 2)					
	MCT26		2.0		μs	$I_C = 2.0$ mA, $V_{CE} = 10$ V

NOTES:
1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

MOC1000 • MOC1001 • MOC1002 • MOC1003

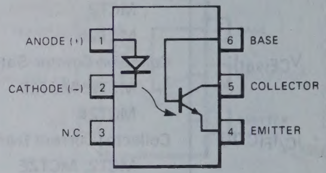
OPTICALLY-COUPLED ISOLATOR

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The MOC1000, MOC1001, MOC1002 and MOC1003 are gallium arsenide light emitting diodes coupled to a silicon phototransistor. They are designed for applications requiring electrical isolation, high-current transfer ratios, small package size and low cost (i.e., interfacing and coupling systems, phase and feedback controls, solid state relays and general purpose switching circuits).

- **EXCELLENT FREQUENCY RESPONSE – 300 kHz (TYP)**
- **HIGH TRANSFER RATIO – 60% (TYP) MOC1000, MOC1001**
- **ECONOMICAL, COMPACT, DUAL IN-LINE PLASTIC PACKAGE**
- **FAST SWITCHING – 2.8 μs (TYP)**
- **GLASSOLATED™**
- **ELECTRICALLY EQUIVALENT TO MOTOROLA DEVICES**
- **PIN-FOR-PIN EQUIVALENT TO MOTOROLA DEVICES**
- **AVAILABILITY OF BASE PIN FOR FLEXIBLE DESIGN**

CONNECTION DIAGRAM
DIP (TOP VIEW)



PIN NUMBERS

1	Anode (+)	Input Diode
2	Cathode (−)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

ABSOLUTE MAXIMUM RATINGS

Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Total Package Power Dissipation at $T_A = 25°C$ (LED plus Detector)	250 mW
Derate Linearly from 25°C	3.3 mW/°C

INPUT DIODE

V_R	Reverse Voltage	3.0 V
I_F	Forward Current	80 mA
i_f	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at $T_A = 25°C$	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

OUTPUT TRANSISTOR

V_{CE}	Collector to Emitter Voltage	30 V
V_{CB}	Collector to Base Voltage	70 V
P_D	Power Dissipation at $T_A = 25°C$	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

ELECTRICAL CHARACTERISTICS – INPUT DIODE: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.2	1.5	V	$I_F = 50$ mA, Pulsed
I_R	Reverse Current		0.05	100	μA	$V_R = 3.0$ V, $R_L = 1.0$ MΩ

ELECTRICAL CHARACTERISTICS – OUTPUT TRANSISTOR: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{CEO}	Collector-Emitter Voltage	30			V	$I_C = 1.0$ mA, $I_B = 0$
V_{CBO}	Collector-Base Voltage	70			V	$I_C = 100\ \mu A$, $I_B = 0$
V_{ECO}	Emitter-Collector Voltage	7.0			V	$I_E = 100\ \mu A$, $I_B = 0$
I_{CEO}	Collector-Emitter Leakage Current		3.5	50	nA	$V_{CE} = 10$ V, $I_F = 0$
I_{CBO}	Collector-Base Leakage Current			20	nA	$V_{CB} = 10$ V, $I_F = 0$
h_{FE}	Forward Current Gain		200			$V_{CE} = 5.0$ V, $I_C = 100\ \mu A$

ELECTRICAL CHARACTERISTICS – COUPLED: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{IO}	Input-to-Output Voltage					
	MOC1000, MOC1002	1500			V_{pk}	
	MOC1001	2500			V_{pk}	
	MOC1003	500			V_{pk}	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage		0.2	0.5	V	$I_C = 2.0$ mA, $I_F = 50$ mA
I_C/I_F(CTR)	Collector Current Transfer Ratio (Note 1)					$V_{CE} = 10$ V, $I_F = 10$ mA
	MOC1000, MOC1001	20	60		%	
	MOC1002, MOC1003	10	30		%	
R_{IO}	Input-to-Output Resistance		10^{11}		Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		1.3		pF	f = 1.0 MHz, V = 0
t_r, t_f	Collector Rise and Fall Times (Note 2)		2.8		μs	$I_C = 2.0$ mA, $V_{CE} = 10$ V, $R_L = 100\ \Omega$

NOTES:
1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

TIL111 • TIL114 • TIL116 • TIL117

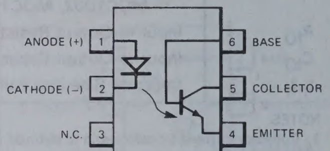
OPTICALLY-COUPLED ISOLATOR

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The TIL111, TIL114, TIL116 and TIL117 series of optically coupled isolators are electrical and mechanical replacement for the Texas Instruments series. Optical intercoupling provides a high degree of ac and dc isolation. Connection to the base is also provided for design flexibility.

- **GLASSOLATED™**
- **HIGH CURRENT TRANSFER RATIO**
- **HIGH-SPEED SWITCHING – TYPICALLY 2 μs**
- **10^{11} Ω ISOLATION RESISTANCE**
- **LOW COUPLING CAPACITANCE – TYPICALLY 1.0 pF**

CONNECTION DIAGRAM
DIP (TOP VIEW)



PIN NUMBERS

1 Anode (+) 2 Cathode (−)	Input Diode
3 NC	
4 Emitter 5 Collector 6 Base	Output npn Phototransistor

ABSOLUTE MAXIMUM RATINGS

Storage Temperature		−55°C to +150°C
Operating Temperature		−55°C to +100°C
Pin Temperature (Soldering, 5 s)		260°C
Total Package Power Dissipation at T_A = 25°C (LED plus Detector)		250 mW
Derate Linearly from 25°C		3.3 mW/°C
INPUT DIODE		
V_R	Reverse Voltage	3.0 V
I_F	Forward Current	100 mA
i_f	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.6 mW/°C
OUTPUT TRANSISTOR		
V_{CE}	Collector to Emitter Voltage	30 V
V_{CB}	Collector to Base Voltage	70 V
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.6 mW/°C

ELECTRICAL CHARACTERISTICS – INPUT DIODE: T_A = 25°C

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage					
	TIL111, TIL114, TIL117		1.2	1.4	V	I_F = 16 mA
	TIL116		1.2	1.5	V	I_F = 60 mA
BV_R	Reverse Breakdown Voltage	3.0	5.0		V	I_R = 10 μA

ELECTRICAL CHARACTERISTICS – OUTPUT TRANSISTOR: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{CEO}	Collector-Emitter Voltage	30			V	$I_C = 1.0$ mA, $I_F = 0$
V_{CBO}	Collector-Base Voltage	70			V	$I_C = 10\ \mu A$, $I_F = 0$
V_{EBO}	Emitter-Base Voltage	7			V	$I_E = 10\ \mu A$
I_{CEO}	Collector-Emitter Leakage Current		1.0	50	nA	$V_{CE} = 10$ V, $I_F = 0$
I_{CBO}	Collector-Base Leakage Current		0.1	20	nA	$V_{CB} = 10$ V, $I_F = 0$
h_{FE}	Forward Current Gain					
	TIL111, TIL114	100	300			$V_{CE} = 5$ V, $I_C = 10$ mA
	TIL116	100	300			$V_{CE} = 5$ V, $I_C = 100\ \mu A$
	TIL117	200	550			$V_{CE} = 5$ V, $I_C = 10$ mA

ELECTRICAL CHARACTERISTICS – COUPLED: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
I_C	Collector Output Current					
	TIL111, TIL114	2.0	7.0		mA	$V_{CE} = 0.4$ V, $I_F = 16$ mA
	TIL116	2.0	5.0		mA	$V_{CE} = 10$ V, $I_F = 10$ mA
	TIL117	5.0	9.0		mA	$V_{CE} = 10$ V, $I_F = 10$ mA
I_B	Collector-Base Current	10	20		µA	$V_{CB} = 0.4$ V, $I_F = 16$ mA
V_{ISO}	Isolation Voltage					
	TIL111	1500			Vdc	
	TIL114, TIL116, TIL117	2500			Vdc	
R_{ISO}	Isolation Resistance	10^{11}			Ω	V = 500 V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage					
	TIL111, TIL114		0.25	0.4	V	$I_C = 2.0$ mA, $I_F = 16$ mA
	TIL116		0.25	0.4		$I_C = 2.2$ mA, $I_F = 15$ mA
	TIL117		0.25	0.4	V	$I_C = 0.5$ mA, $I_F = 10$ mA
C_{ISO}	Isolation Capacitance		1.0	1.3	pF	V = 0, f = 1.0 MHz
t_{on}, t_{off}	Turn-on, Turn-off Time					$I_C = 2.0$ mA, $V_{CC} = 10$ V, $R_L = 100\ \Omega$ (See Note 2)
	TIL111, TIL114		2	5	µs	
	TIL116		2	7	µs	
	TIL117		2	9	µs	

NOTES:

1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

6

TIL112 • TIL115 • TIL118

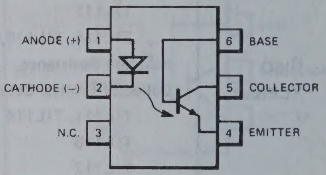
OPTICALLY-COUPLED ISOLATOR

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The TIL112, TIL115 and TIL118 series of optical isolators are electrical and mechanical replacements for the Texas Instrument series. Optical intercoupling provides a high degree of ac and dc isolation. Connection to the base is also provided for design flexibility.

- **GLASSOLATED™**
- **HIGH CURRENT TRANSFER RATIO**
- **HIGH-SPEED SWITCHING – TYPICALLY 2 μs**
- **10^{11} Ω ISOLATION RESISTANCE**
- **LOW COUPLING CAPACITANCE – TYPICALLY 1.0 pF**

CONNECTION DIAGRAM
DIP (TOP VIEW)



PIN NUMBERS

1	Anode (+)	Input Diode
2	Cathode (–)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

ABSOLUTE MAXIMUM RATINGS

Storage Temperature		−55°C to +150°C
Operating Temperature		−55°C to +100°C
Pin Temperature (Soldering, 5 s)		260°C
Total Package Power Dissipation at T_A = 25°C (LED plus Detector)		250 mW
Derate Linearly from 25°C		3.3 mW/°C
INPUT DIODE		
V_R	Reverse Voltage	3.0 V
I_F	Forward Current	100 mA
i_f	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C
OUTPUT TRANSISTOR		
V_{CE}	Collector to Emitter Voltage	20 V
V_{CB}	Collector to Base Voltage	30 V
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

ELECTRICAL CHARACTERISTICS – INPUT DIODE: T_A = 25°C

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage		1.2	1.5	V	I_F = 10 mA
BV_R	Reverse Breakdown Voltage	3.0	5.0		V	I_R = 10 μA

ELECTRICAL CHARACTERISTICS – OUTPUT TRANSISTOR: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{CEO}	Collector-Emitter Voltage	20			V	$I_C = 1.0$ mA, $I_F = 0$
V_{CBO}	Collector-Base Voltage	30			V	$I_C = 10\ \mu A$, $I_F = 0$
V_{EBO}	Emitter-Collector Voltage (V_{ECO} on TIL118)	4.0			V	$I_E = 10\ \mu A$, $I_F = 0$
I_{CEO}	Collector-Emitter Leakage Current		1.0	100	nA	$V_{CE} = 5.0$ V, $I_F = 0$
I_{CBO}	Collector-Base Leakage Current		0.1	50	nA	$V_{CB} = 5.0$ V, $I_F = 0$
h_{FE}	Forward Current Gain	50	200			$V_{CE} = 5.0$ V, $I_C = 10\ \mu A$

ELECTRICAL CHARACTERISTICS – COUPLED: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
I_C	Collector Output Current					
	TIL112, TIL115	0.2	2.0		mA	$V_{CE} = 5.0$ V, $I_F = 10$ mA
	TIL118	1.0	2.0		mA	$V_{CE} = 5.0$ V, $I_F = 10$ mA
I_B	Collector-Base Current					
	TIL112, TIL115	2	10		µA	$V_{CB} = 5.0$ V, $I_F = 10$ mA
V_{ISO}	Isolation Voltage					
	TIL112, TIL118	1500			Vdc	
	TIL115	2500			Vdc	
R_{ISO}	Isolation Resistance		10^{11}		Ω	V = 500 V
C_{ISO}	Isolation Capacitance			2	pF	f = 1 MHz
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage			0.5	V	$I_C = 2.0$ mA, $I_F = 50$ mA
t_{on}	Turn-on Time		2.0	15	µs	$I_C = 2.0$ mA, $V_{CC} = 10$ V, $R_L = 100\ \Omega$
t_{off}	Turn-off Time (See Note 1)		2.0	15	µs	$I_C = 2.0$ mA, $V_{CC} = 10$ V, $R_L = 100\ \Omega$

NOTES:
1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

TIL113 • TIL119

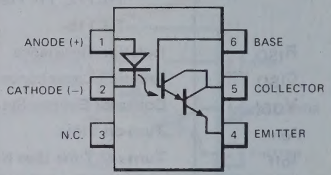
OPTICALLY—COUPLED DARLINGTON ISOLATOR

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The TIL113 and TIL119 optical isolators are electrical and mechanical replacements for the Texas Instrument series. Optical coupling provides a high degree of ac and dc isolation. A capability for continuous operation of the input diode results in a frequency response extending to dc. Connection to the base is also provided for design flexibility.

- **GLASSOLATED™**
- **ELECTRICALLY EQUIVALENT TO TI DEVICES**
- **PIN-FOR-PIN EQUIVALENT**
- **AVAILABILITY OF BASE PIN FOR FLEXIBLE DESIGN**

CONNECTION DIAGRAM
DIP (TOP VIEW)



PIN NUMBERS

1	Anode (+)	Input Diode
2	Cathode (–)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

ABSOLUTE MAXIMUM RATINGS

Storage Temperature		−55°C to +150°C
Operating Temperature		−55°C to +100°C
Pin Temperature (Soldering, 10 s)		260°C
Total Package Power Dissipation at $T_A = 25°C$ (LED plus Detector)		250 mW
Derate Linearly from 25°C		3.3 mW/°C
INPUT DIODE		
I_F	Forward dc Current Continuous	100 mA
V_R	Reverse Voltage	3.0 V
i_f	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at $T_A = 25°C$	150 mW
	Derate Linearly from 25°C	2.0 mW/°C
OUTPUT TRANSISTOR (DARLINGTON)		
V_{CEO}	Collector to Emitter Voltage	30 V
V_{CBO}	Collector to Base Voltage	30 V
V_{ECO}	Emitter to Collector Voltage	7.0 V
P_D	Power Dissipation at $T_A = 25°C$ (Max I_C 100 mA at $V_{CE} = 1.5$ V)	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

ELECTRICAL CHARACTERISTICS – INPUT DIODE: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F	Forward Voltage			1.5	V	$I_F = 10$ mA
I_R	Reverse Current			100	μA	$V_R = 3.0$ V

ELECTRICAL CHARACTERISTICS – OUTPUT TRANSISTOR (DARLINGTON): $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
BV_{CEO}	Collector-Emitter Breakdown Voltage	30			V	$I_C = 1.0$ mA, $I_F = 0$
BV_{CBO}	Collector-Base Breakdown Voltage TIL113	30				IC = 10 μA, $I_F = 0$
BV_{ECO}	Emitter-Collector Breakdown Voltage TIL119	7.0			V	$I_E = 10\ \mu$A, $I_F = 0$
BV_{EBO}	Emitter-Base Breakdown Voltage TIL113	7.0			V	$I_E = 10\ \mu$A, $I_F = 0$
I_{CEO}	Collector-Emitter Leakage Current				nA	$V_{CE} = 10$ V, $I_F = 0$
h_{FE}	DC Forward Current Gain TIL113		15,000			$V_{CE} = 1.0$ V, $I_C = 10$ mA, $I_F = \phi$

ELECTRICAL CHARACTERISTICS – COUPLED ($T_A = 25°C$)

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
I_C	Collector Output Current (Pulsed)					
	TIL113	30	100		mA	$I_F = 10$ mA, $V_{CE} = 1.0$ V
	TIL119	30	160		mA	$I_F = 10$ mA, $V_{CE} = 2.0$ V
V_{ISO}	Isolation Voltage (Note 2)	1500			V	Peak
R_{ISO}	Isolation Resistance	10^{11}			Ω	V = 500 V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage					
	TIL113			1.0	V	$I_C = 125$ mA, $I_B = 0$, $I_F = 50$ mA
	TIL119			1.0	V	$I_C = 10$ mA, $I_F = 10$ mA
C_{ISO}	Isolation Capacitance		1.0	1.3	pF	V = 0, f = 1.0 MHz
t_{on}, t_{off}	Turn-on, Turn-off Time (Note 1) TIL113		50		μs	$I_C = 125$ mA, $V_{CC} = 15$ V, $R_L = 100\ \Omega$
t_{on}, t_{off}	Turn-on, Turn-off Time (Note 1) TIL119		50		μs	$I_C = 2.5$ mA, $V_{CC} = 10$ V, $R_L = 100\ \Omega$

NOTES:
1. Turn-on time is defined as the time for the (base collector) current to rise from 10% to 90% of peak value. Turn-off time is defined as the time required for the current to decrease from 90% to 10% of peak value.
2. Isolation voltage defined as min of 5 seconds continuous application.

4N25 • 4N26 • 4N27 • 4N28

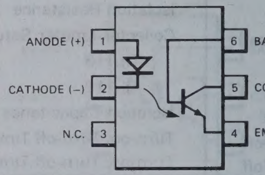
OPTICALLY-COUPLED ISOLATOR

OPTOELECTRONICS PRODUCT GROUP

GENERAL DESCRIPTION – The 4N25, 4N26, 4N27 and 4N28 series of optoisolators have a npn silicon Planar* phototransistor coupled to a gallium arsenide diode. Each is mounted in a 6-pin plastic dual in-line package.

- **GLASSOLATED™**
- **HIGH CURRENT TRANSFER RATIO – TYPICALLY 50%**
- **500 V TO 2500 V MINIMUM ISOLATION INPUT-TO-OUTPUT**
- **10^{11} Ω ISOLATION RESISTANCE**
- **LOW COUPLING CAPACITANCE – TYPICALLY 1.0 pF**

CONNECTION DIAGRAM DIP (TOP VIEW)



PIN NUMBERS

1	Anode (+)	Input Diode
2	Cathode (−)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

ABSOLUTE MAXIMUM RATINGS

Storage Temperature**		−55°C to 150°C
Operating Temperature		−55°C to 100°C
Pin Temperature (Soldering, 10 s)**		260°C
Total Package Power Dissipation at T_A = 25°C** (LED plus Detector)		250 mW
Derate Linearly from 25°C**		3.3 mW/°C
INPUT DIODE		
V_R**	Reverse Voltage	3.0 V
I_F**	Forward Current	80 mA
i_f**	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D**	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C
OUTPUT TRANSISTOR		
V_{CE}**	Collector to Emitter Voltage	30 V
V_{CB}**	Collector to Base Voltage	70 V
V_{EC}**	Emitter to Collector Voltage	7.0 V
P_D**	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

ELECTRICAL CHARACTERISTICS – INPUT DIODE: T_A = 25°C

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F**	Forward Voltage		1.2	1.5	V	I_F = 50 mA
I_R**	Reverse Leakage Current		0.05	100	μA	V_R = 3.0 V, R_L = 1 MΩ
C	Capacitance		150		pF	V_R = 0 V, f = 1 MHz

**Indicates JEDEC registered values.

*Planar is a patented Fairchild process.

ELECTRICAL CHARACTERISTICS – OUTPUT TRANSISTOR: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{CEO}**	Collector-Emitter Voltage	30	65		V	$I_C = 1.0$ mA, $I_B = 0$
V_{CBO}**	Collector-Base Voltage	70	165		V	$I_C = 100\ \mu A$, $I_E = 0$
V_{ECO}**	Emitter-Collector Voltage	7.0	14		V	$I_E = 100\ \mu A$, $I_B = 0$
I_{CEO}**	Collector-Emitter Leakage Current					
	4N25, 4N26, 4N27		3.5	50	nA	$V_{CE} = 10$ V, Base Open
	4N28			100	nA	$V_{CE} = 10$ V, Base Open
I_{CBO}**	Collector-Base Leakage Current		0.1	20	nA	$V_{CB} = 10$ V, Emitter Open
h_{FE}	Forward Current Gain		250			$V_{CE} = 5.0$ V, $I_C = 500\ \mu A$
C_{cb}	Collector-Base Capacitance		65		pF	$V_{CB} = 0$, f = 1 MHz

ELECTRICAL CHARACTERISTICS – COUPLED: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{IO}**	Input-to-Output Voltage					
	4N25	2500			V_{pk}	
	4N26, 4N27	1500			V_{pk}	
	4N28	500			V_{pk}	
$V_{CE(sat)}$**	Collector-Emitter Saturation Voltage		0.2	0.5	V	$I_C = 2.0$ mA, $I_F = 50$ mA
I_C**	Collector Output Current					
	4N25, 4N26	2.0	5.0		mA	$V_{CE} = 10$ V, $I_F = 10$ mA, $I_B = 0$
	4N27, 4N28	1.0	3.0		mA	$V_{CE} = 10$ V, $I_F = 10$ mA, $I_B = 0$
R_{IO}	Input-to-Output Resistance		10^{11}		Ω	$V_{IO} = 500$ V
BW	Collector Bandwidth		300		kHz	$I_C = 2.0$ mA, $V_{CC} = 10$ V, $R_L = 100\ \Omega$
C_{IO}	Input-to-Output Capacitance		1.3		pF	$V_{IO} = 0$, f = 1.0 MHz

**Indicates JEDEC registered values.

4N29 • 4N30 • 4N31 • 4N32 • 4N33

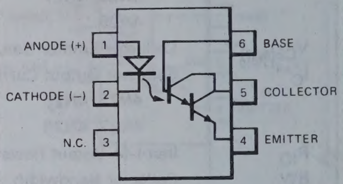
OPTICALLY-COUPLED DARLINGTON ISOLATOR

OPTOELECTRONICS PRODUCTS GROUP

GENERAL DESCRIPTION – The 4N29, 4N30, 4N31, 4N32 and 4N33 series of opto-isolators have a npn silicon Planar* photo-Darlington transistor coupled to a gallium arsenide diode. Each is mounted in a six pin plastic DIP package.

- **HIGH CURRENT TRANSFER RATIO**
- **1500 or 2500 V MINIMUM ISOLATION INPUT-TO-OUTPUT**
- **10^{11} Ω ISOLATION RESISTANCE**
- **LOW COUPLING CAPACITANCE**

CONNECTION DIAGRAM
DIP (TOP VIEW)



PIN NUMBERS

Pin		
1 Anode (+)	}	Input Diode
2 Cathode (–)		
3 NC		
4 Emitter	}	Output npn Phototransistor
5 Collector		
6 Base		

ABSOLUTE MAXIMUM RATINGS

Storage Temperature**		−55°C to 150°C
Operating Temperature		−55°C to 100°C
Pin Temperature (Soldering, 10 s)**		260°C
Total Package Power Dissipation at T_A = 25°C (LED plus Detector)**		250 mW
Derate Linearly from 25°C**		3.3 mW/°C
INPUT DIODE**		
I_F	Forward dc Current Continuous	80 mA
V_R	Reverse Voltage	3.0 V
i_f	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C
OUTPUT TRANSISTOR (DARLINGTON)**		
V_{CEO}	Collector to Emitter Voltage	30 V
V_{CBO}	Collector to Base Voltage	50 V
V_{EBO}	Emitter to Base Voltage	8.0 V
V_{ECO}	Emitter to Collector Voltage	5.0 V
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

ELECTRICAL CHARACTERISTICS – **INPUT DIODE:** T_A = 25°C

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F**	Forward Voltage		1.2	1.5	V	I = 50 mA
I_R**	Reverse Leakage Current		0.05	100	μA	V_R = 3.0 V
C	Capacitance		150		pF	V_R = 0 V, f = 1 MHz

ELECTRICAL CHARACTERISTICS – OUTPUT TRANSISTOR (DARLINGTON): $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
BV_{CEO}**	Collector-Emitter Breakdown Voltage	30	70		V	$I_C = 100\ \mu A$, $I_B = 0$
BV_{CBO}**	Collector-Base Breakdown Voltage	30			V	$I_C = 100\ \mu A$, $I_E = 0$
BV_{ECO}**	Emitter-Collector Breakdown Voltage	5.0			V	$I_E = 100\ \mu A$, $I_B = 0$
I_{CEO}**	Collector-Emitter Dark Current			100	nA	$V_{CE} = 10$ V, Base Open
h_{FE}	DC Current Gain		2000			$V_{CE} = 5.0$ V, $I_C = 500\ \mu A$

ELECTRICAL CHARACTERISTICS – COUPLED: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
I_C**	Collector Output Current					
	4N32, 4N33	50			mA	$V_{CE} = 10$ V, $I_F = 10$ mA
	4N29, 4N30	10			mA	$V_{CE} = 10$ V, $I_F = 10$ mA
	4N31	5.0			mA	$V_{CE} = 10$ V, $I_F = 10$ mA
V_{ISO}**	Isolation Voltage					
	4N29, 4N32	2500			Vdc	
	4N30, 4N31, 4N33	1500			Vdc	
R_{ISO}**	Isolation Resistance		10^{11}		Ω	V = 500 V
$V_{CE(sat)}$**	Collector-Emitter Saturation Voltage					
	4N31			1.2	V	$I_C = 2.0$ mA, $I_F = 8.0$ mA
	4N29, 4N30, 4N32, 4N33			1.0	V	$I_C = 2.0$ mA, $I_F = 8.0$ mA
C_{ISO}	Isolation Capacitance		1.5		pF	V = 0, f = 1.0 MHz
t_{on}	Turn-on Time		10		μs	$I_C = 50$ mA, $V_{CC} = 10$ V, $R_L = 180\ \Omega$, $I_F = 200$ mA
t_{off}	Turn-off Time (See Note 1)					
	4N29, 4N30, 4N31		20	45	μs	$I_C = 50$ mA, $V_{CC} = 10$ V, $R_L = 180\ \Omega$, $I_F = 200$ mA
	4N32, 4N33		60	120	μs	

*Planar is a patented Fairchild process.
**Indicates JEDEC Registered Data.

NOTE:
1. Turn-on time is defined as the time for the (base collector) current to rise from 10% to 90% of peak value. Turn-off time is defined as the time required for the current to decrease from 90% to 10% of peak value.

4N35 • 4N36 • 4N37

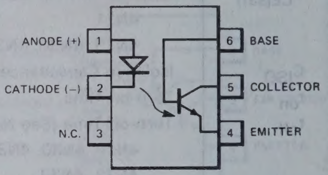
OPTICALLY-COUPLED ISOLATOR

OPTOELECTRONICS PRODUCTS GROUP

GENERAL DESCRIPTION – The 4N35, 4N36 and 4N37 series of optoisolators have a npn silicon Planar* phtotransistor in close proximity to a gallium arsenide diode. Optical coupling provides a high degree of ac and dc isolation. A capability for continuous operation of the input diode results in a frequency response extending to dc. Connection to the transistor base is also provided for design flexibility. This isolator series is covered under U.L. component recognition program, reference file E55299.

- **GLASSOLATED™**
- **HIGH CURRENT TRANSFER RATIO – MINIMUM 100%**
- **1500 V TO 3500 V MINIMUM ISOLATION INPUT-TO-OUTPUT**
- **10^{11} Ω ISOLATION RESISTANCE**
- **LOW COUPLING CAPACITANCE – TYPICALLY 1.0 pF**

CONNECTION DIAGRAM
DIP (TOP VIEW)



PIN NUMBERS

1	Anode (+)	Input Diode
2	Cathode (–)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

ABSOLUTE MAXIMUM RATINGS

Storage Temperature**		–55°C to +150°C
Operating Temperature		–55°C to +100°C
Pin Temperature (Soldering, 10 s)**		260°C
Relative Humidity at 85°C**		85%
INPUT DIODE		
V_R**	Reverse Voltage	6.0 V
I_F**	Forward Current	60 mA
i_f**	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D**	Power Dissipation at $T_A = 25°C$	100 mW
	Derate Linearly from 25°C	1.33 mW/°C
OUTPUT TRANSISTOR		
V_{CE}**	Collector to Emitter Voltage	30 V
V_{CB}**	Collector to Base Voltage	70 V
V_{EC}**	Emitter to Collector Voltage	7.0 V
I_C**	Collector Current	100 mA
P_D**	Power Dissipation at $T_A = 25°C$	300 mW
	Derate Linearly from 25°C	4.0 mW/°C

ELECTRICAL CHARACTERISTICS – INPUT DIODE: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_F**	Forward Voltage	0.8		1.5	V	$I_F = 10$ mA
I_R**	Reverse Leakage Current		.01	10	μA	$V_R = 6.0$ V
C	Capacitance			100	pF	$V_R = 0$ V, f = 1 MHz

**Indicates JEDEC registered values.

*Planar is a patented Fairchild process.

ELECTRICAL CHARACTERISTICS – OUTPUT TRANSISTOR: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{CEO}**	Collector-Emitter Voltage	30	65		V	$I_C = 10$ mA
V_{CBO}**	Collector-Base Voltage	70	165		V	$I_C = 100\ \mu A$
V_{ECO}**	Emitter-Collector Voltage	7.0	14		V	$I_E = 100\ \mu A$, $I_F = 0$
I_{CEO}*	Collector-Emitter Leakage Current		5	50	nA	$V_{CE} = 10$ V, $I_F = 0$
I_{CEO}**	Collector-Emitter Leakage Current			500	μA	$V_{CE} = 30$ V, $I_F = 0$, $T_A = 100°C$
h_{FE}	Forward Current Gain	100	250			$V_{CE} = 5.0$ V, $I_C = 100\ \mu A$
C_{cb}	Collector-Base Capacitance		25		pF	$V_{CB} = 10$

ELECTRICAL CHARACTERISTICS – COUPLED: $T_A = 25°C$

SYMBOL	CHARACTERISTIC	MIN	TYP	MAX	UNITS	TEST CONDITIONS
I_{IO}**	Input-to-Output Current					Pulse Width = 8 ms
	4N35			100	μA	$V_{IO} = 3550$ V
	4N36			100	μA	$V_{IO} = 2500$ V
	4N37			100	μA	$V_{IO} = 1500$ V
$V_{CE(sat)}$**	Collector-Emitter Saturation Voltage			0.3	V	$I_C = 0.5$ mA, $I_F = 10$ mA
I_C/I_F(CTR)**	Collector Current Transfer Ratio (Note 1)	100			%	$V_{CE} = 10$ V, $I_F = 10$ mA
I_C/I_F(CTR)**	Collector Current Transfer Ratio (Note 1)	40			%	$V_{CE} = 10$ V, $I_F = 10$ mA $T_A = -55°C$ to 100°C
R_{IO}**	Input-to-Output Resistance	10^{11}			Ω	$V_{IO} = 500$ V
C_{IO}**	Input-to-Output Capacitance		1.0	2.5	pF	$V_{IO} = 0$, f = 1.0 MHz
t_{on}	Turn-on Time		5	10	μs	$I_C = 2.0$ mA, $V_{CC} = 10$ V, $R_L = 100\ \Omega$
t_{off}	Turn-off Time		5	10	μs	$I_C = 2.0$ mA, $V_{CC} = 10$ V, $R_L = 100\ \Omega$

**Indicates JEDEC registered values.

NOTES:

1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.

OPTOELECTRONIC TECHNOLOGY 1

DISCRETE LED DIGIT RELIABILITY 2

VISIBLE LED LAMPS AND MOUNTING HARDWARE 3

SEVEN-SEGMENT DISPLAYS AND DISPLAY ARRAYS 4

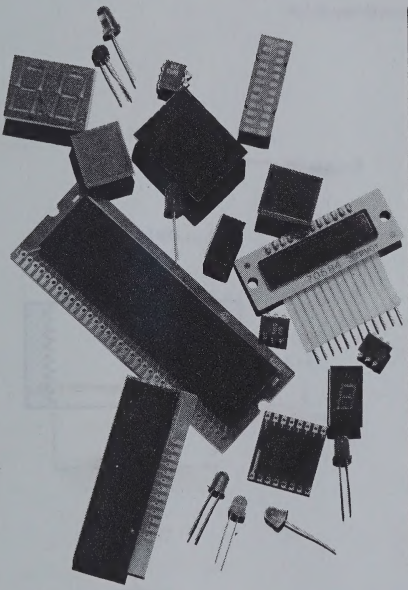
PHOTOTRANSISTORS, INFRARED EMITTERS, AND SENSORS 5

PHOTOCOUPLERS 6

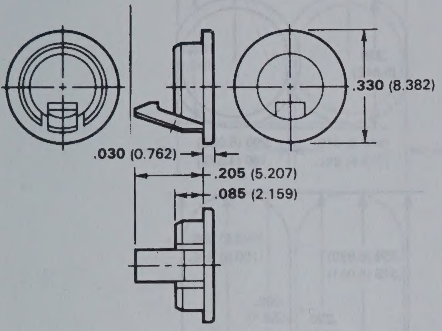
PACKAGE OUTLINES 7

DEFINITIONS OF SYMBOLS AND TERMS 8

FAIRCHILD FIELD SALES OFFICES, SALES REPRESENTATIVES AND DISTRIBUTOR LOCATIONS 9



Opto - 1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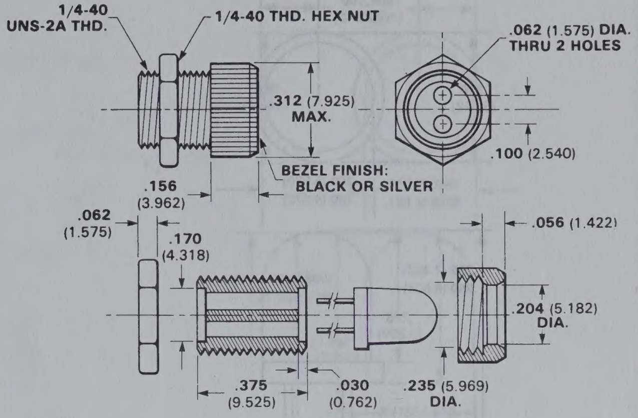
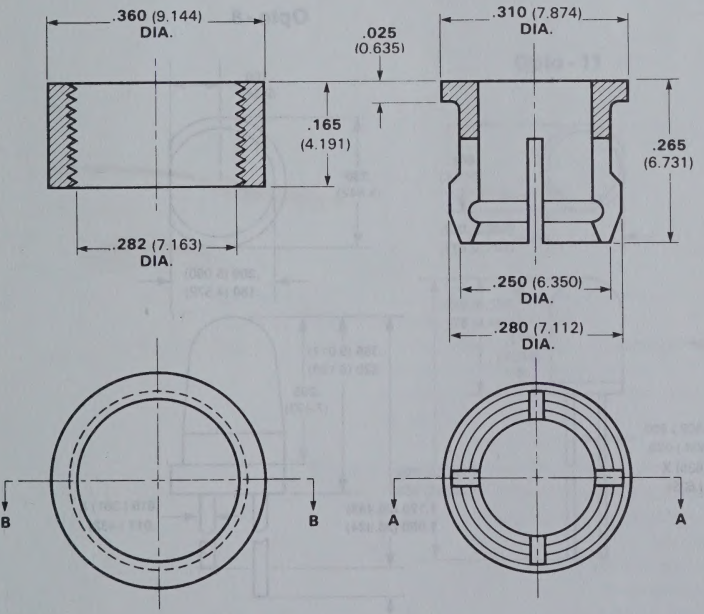
.030 (0.762)
.205 (5.207)
.085 (2.159)

Opto - 2

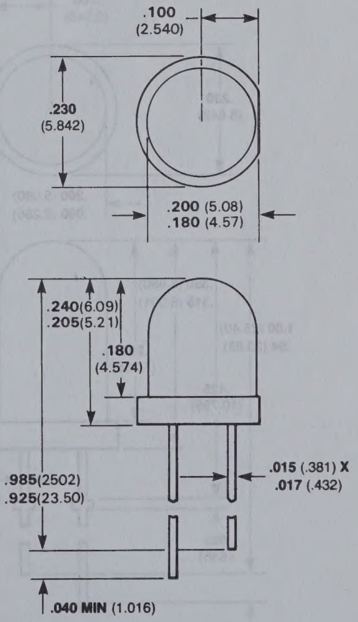

1/4-40
UNS-2A THD.
1/4-40 THD. HEX NUT
.062 (1.575) DIA.
THRU 2 HOLES
.312 (7.925)
MAX.
.100 (2.540)
BEZEL FINISH:
BLACK OR SILVER
.156
(3.962)
.062
(1.575)
.170
(4.318)
.056 (1.422)
.204 (5.182)
DIA.
.375
(9.525)
.030
(0.762)
.235 (5.969)
DIA.

NOTES:
All dimensions in inches (bold) and millimeters (parentheses)

Opto - 3


.360 (9.144)
DIA.
.025
(0.635)
.310 (7.874)
DIA.
.165
(4.191)
.265
(6.731)
.282 (7.163)
DIA.
.250 (6.350)
DIA.
.280 (7.112)
DIA.
B
B
A
A

Opto - 4

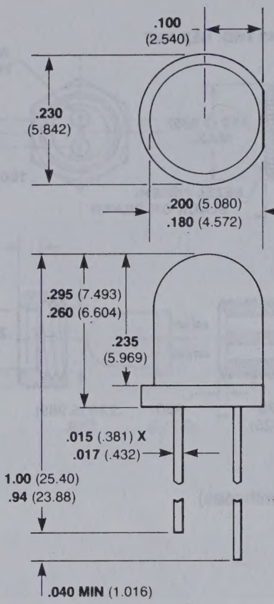

.100
(2.540)
.230
(5.842)
.200 (5.08)
.180 (4.57)
.240(6.09)
.205(5.21)
.180
(4.574)
.015 (.381) X
.017 (.432)
.985(2502)
.925(23.50)
.040 MIN (1.016)

NOTES:
All dimensions in inches (bold) and millimeters (parentheses)

NOTES:
All dimensions in inches (bold) and millimeters (parentheses)
Tolerance unless specified = ±.015 (±.381)

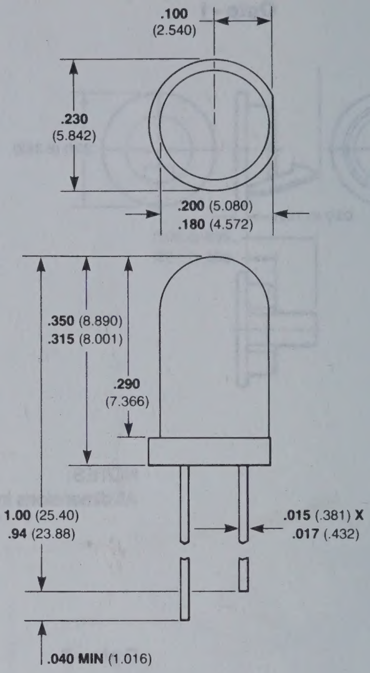
FAIRCHILD PACKAGE OUTLINES

Opto - 5



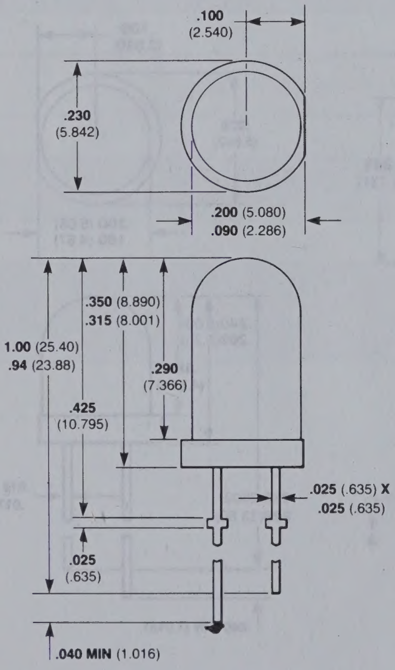
.100 (2.540)
.230 (5.842)
.200 (5.080)
.180 (4.572)
.295 (7.493)
.260 (6.604)
.235 (5.969)
.015 (.381) **X**
.017 (.432)
1.00 (25.40)
.94 (23.88)
.040 MIN (1.016)

Opto - 6



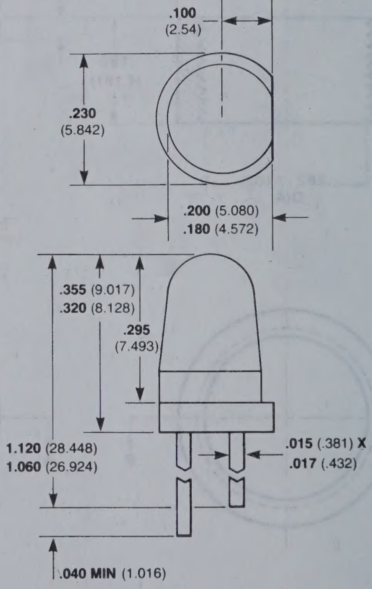
.100 (2.540)
.230 (5.842)
.200 (5.080)
.180 (4.572)
.350 (8.890)
.315 (8.001)
.290 (7.366)
1.00 (25.40)
.94 (23.88)
.015 (.381) **X**
.017 (.432)
.040 MIN (1.016)

Opto - 7



.100 (2.540)
.230 (5.842)
.200 (5.080)
.090 (2.286)
.350 (8.890)
.315 (8.001)
1.00 (25.40)
.94 (23.88)
.290 (7.366)
.425 (10.795)
.025 (.635) **X**
.025 (.635)
.025 (.635)
.040 MIN (1.016)

Opto - 8

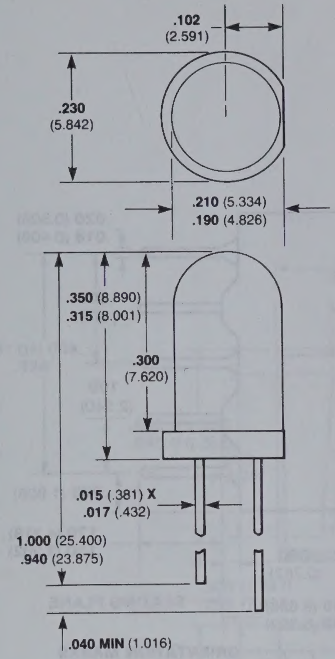


.100 (2.54)
.230 (5.842)
.200 (5.080)
.180 (4.572)
.355 (9.017)
.320 (8.128)
.295 (7.493)
1.120 (28.448)
1.060 (26.924)
.015 (.381) **X**
.017 (.432)
.040 MIN (1.016)

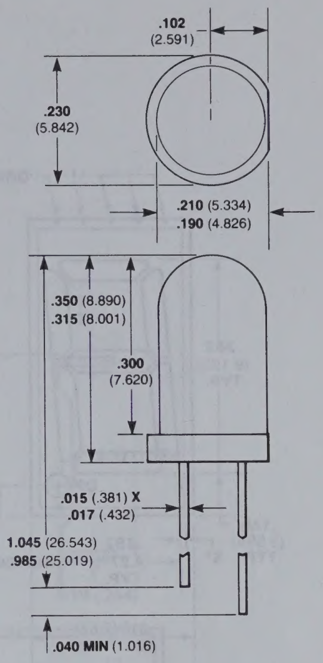
NOTES:
All dimensions in inches (bold) and millimeters (parentheses)
Tolerance unless specified = ±.015 (±.381)

FAIRCHILD PACKAGE OUTLINES

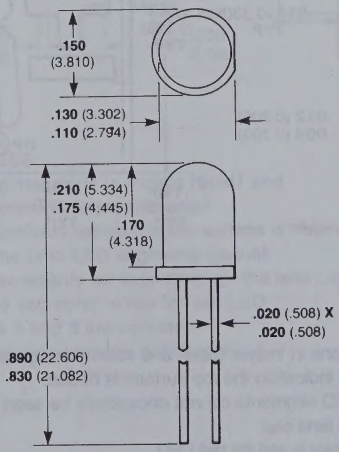
Opto - 9


.102
(2.591)
.230
(5.842)
.210 (5.334)
.190 (4.826)
.350 (8.890)
.315 (8.001)
.300
(7.620)
.015 (.381) X
.017 (.432)
1.000 (25.400)
.940 (23.875)
.040 MIN (1.016)

Opto - 10

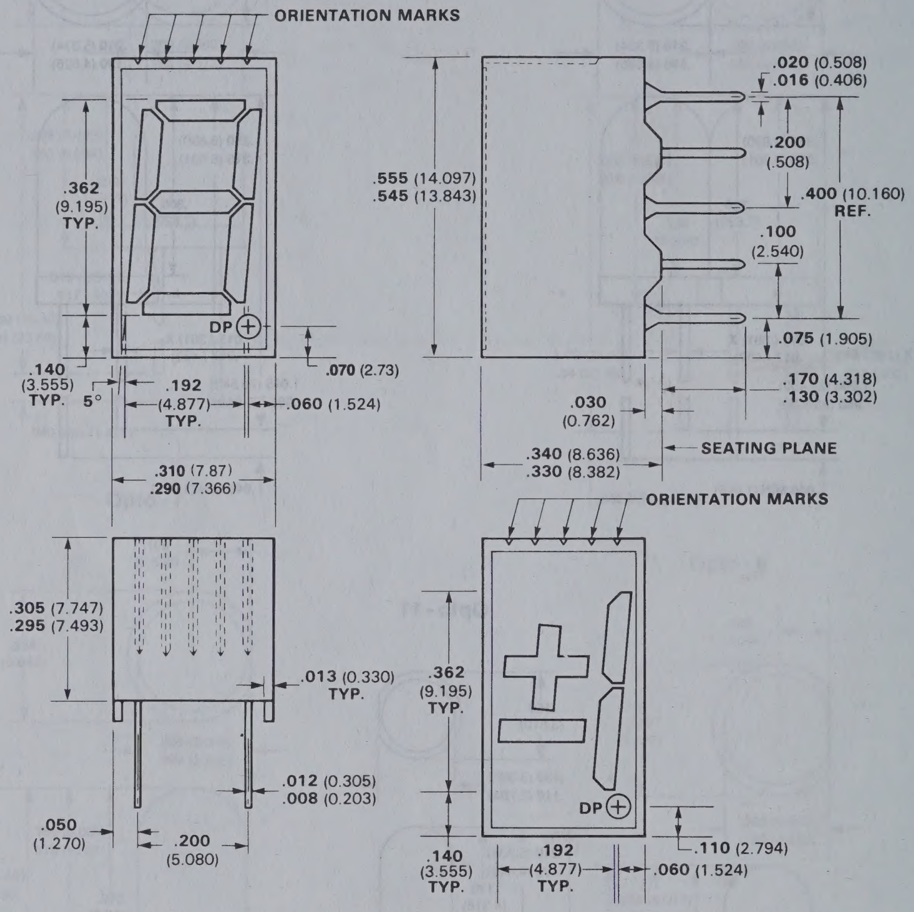

.102
(2.591)
.230
(5.842)
.210 (5.334)
.190 (4.826)
.350 (8.890)
.315 (8.001)
.300
(7.620)
.015 (.381) X
.017 (.432)
1.045 (26.543)
.985 (25.019)
.040 MIN (1.016)

Opto - 11


.150
(3.810)
.130 (3.302)
.110 (2.794)
.210 (5.334)
.175 (4.445)
.170
(4.318)
.020 (.508) X
.020 (.508)
.890 (22.606)
.830 (21.082)

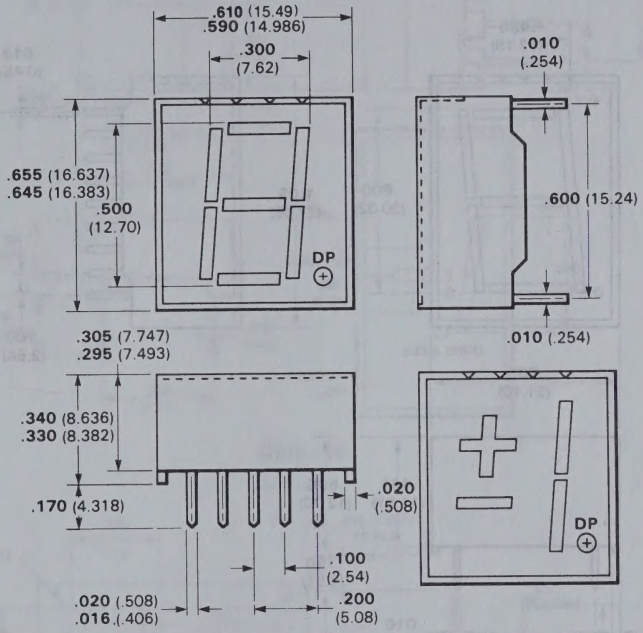
NOTES:
All dimensions in inches (bold) and millimeters (parentheses)
Tolerance unless specified = ±.015 (±.381)

Opto - 12


ORIENTATION MARKS
.362
(9.195)
TYP.
DP
.140
(3.555)
TYP.
5°
.192
(4.877)
TYP.
.060 (1.524)
.070 (2.73)
.310 (7.87)
.290 (7.366)
.555 (14.097)
.545 (13.843)
.020 (0.508)
.016 (0.406)
.200
(.508)
.400 (10.160)
REF.
.100
(2.540)
.075 (1.905)
.170 (4.318)
.130 (3.302)
.030
(0.762)
SEATING PLANE
.340 (8.636)
.330 (8.382)
ORIENTATION MARKS
.305 (7.747)
.295 (7.493)
.013 (0.330)
TYP.
.012 (0.305)
.008 (0.203)
.050
(1.270)
.200
(5.080)
.362
(9.195)
TYP.
DP
.140
(3.555)
TYP.
.192
(4.877)
TYP.
.060 (1.524)
.110 (2.794)

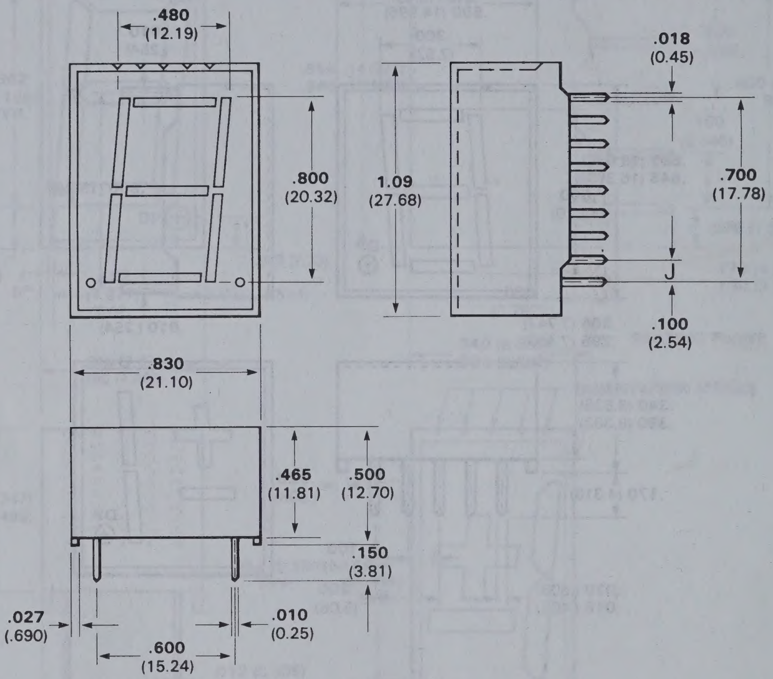
NOTES:
All dimensions in inches (bold) and millimeters (parentheses)
For polarity indication the top surface is ribbed.
The unit LED segments cannot necessarily be seen
through the lens cap.
Lens cap color is red for red LED.
Pins 1 and 6 are common.
All dimensions are ±.015 inch.

Opto - 13


.610 (15.49)
.590 (14.986)
.300
(7.62)
.010
(.254)
.655 (16.637)
.645 (16.383)
.500
(12.70)
DP
.600 (15.24)
.010 (.254)
.305 (7.747)
.295 (7.493)
.340 (8.636)
.330 (8.382)
.170 (4.318)
.020
(.508)
.100
(2.54)
.020 (.508)
.016 (.406)
.200
(5.08)
DP

NOTES:
All dimensions in inches (bold) and millimeters (parentheses)
For polarity indication the surface is ribbed. The unlit LED segments cannot necessarily be seen through the lens cap.
Lens cap color is red for red LED
Pins 3 and 8 are common
All dimensions are ±.015 inch

Opto - 14


.480
(12.19)
.018
(0.45)
.800
(20.32)
1.09
(27.68)
.700
(17.78)
J
.100
(2.54)
.830
(21.10)
.465
(11.81)
.500
(12.70)
.150
(3.81)
.027
(.690)
.010
(0.25)
.600
(15.24)

NOTES:

All dimensions in inches (bold) and millimeters (parentheses)

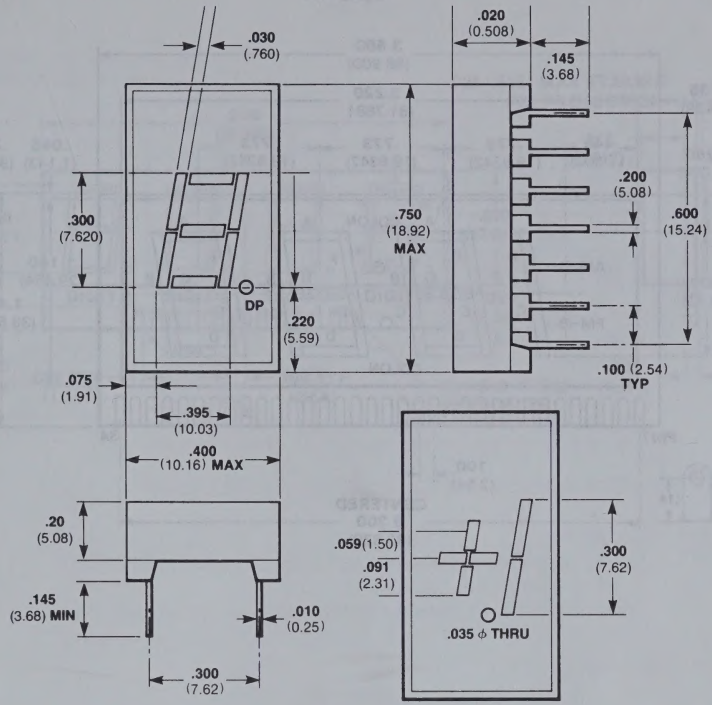
For polarity indication the surface is ribbed. The unlit LED segments cannot necessarily be seen through the lens cap.

Lens cap color is red for red LED

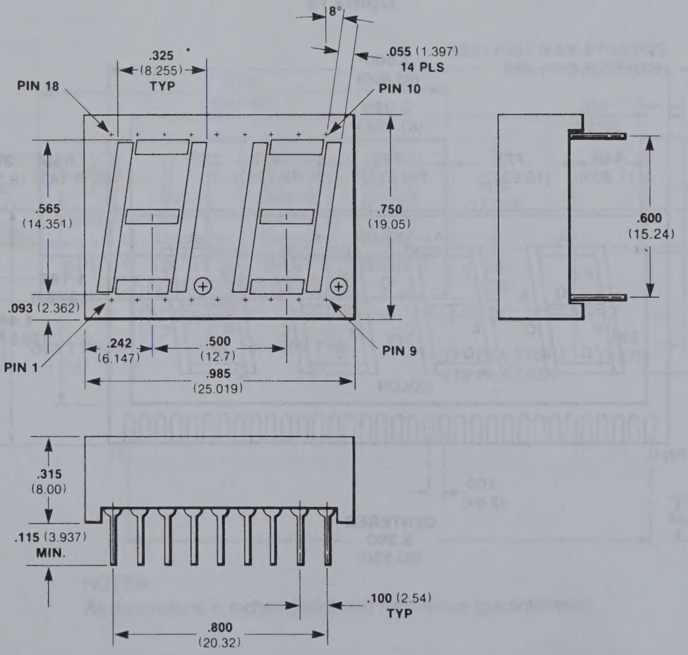
Pins 4, 6, 12 and 17 are common

All dimensions are ±.015 inch

Opto - 15


.030
(.760)
.020
(0.508)
.145
(3.68)
.300
(7.620)
.750
(18.92)
MAX
.200
(5.08)
.600
(15.24)
DP
.220
(5.59)
.075
(1.91)
.395
(10.03)
.400
(10.16) MAX
.100 (2.54)
TYP
.20
(5.08)
.059(1.50)
.091
(2.31)
.300
(7.62)
.145
(3.68) MIN
.010
(0.25)
.035 ϕ THRU
.300
(7.62)

Opto - 16


8°
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(8.255)
TYP
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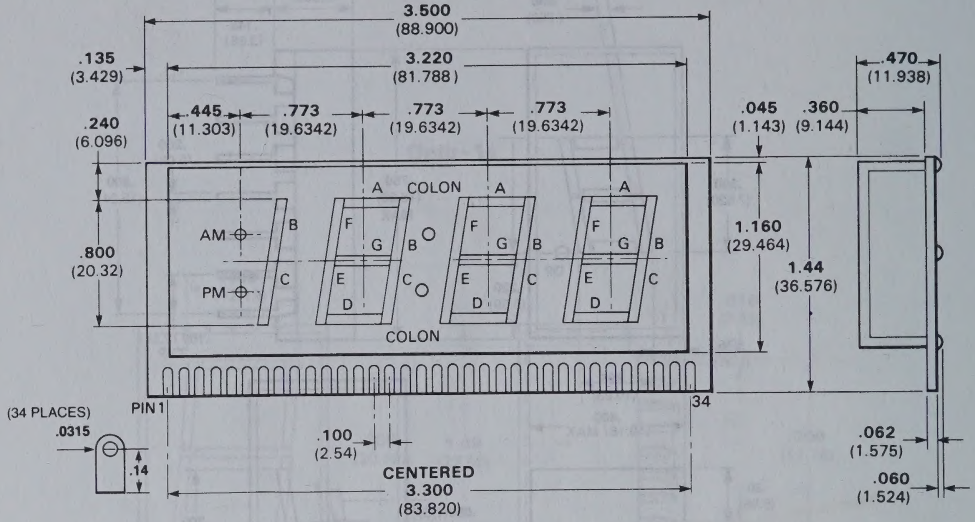
14 PLS
PIN 18
PIN 10
.565
(14.351)
.750
(19.05)
.600
(15.24)
.093 (2.362)
PIN 1
.242
(6.147)
.500
(12.7)
PIN 9
.985
(25.019)
.315
(8.00)
.115 (3.937)
MIN.
.100 (2.54)
TYP
.800
(20.32)

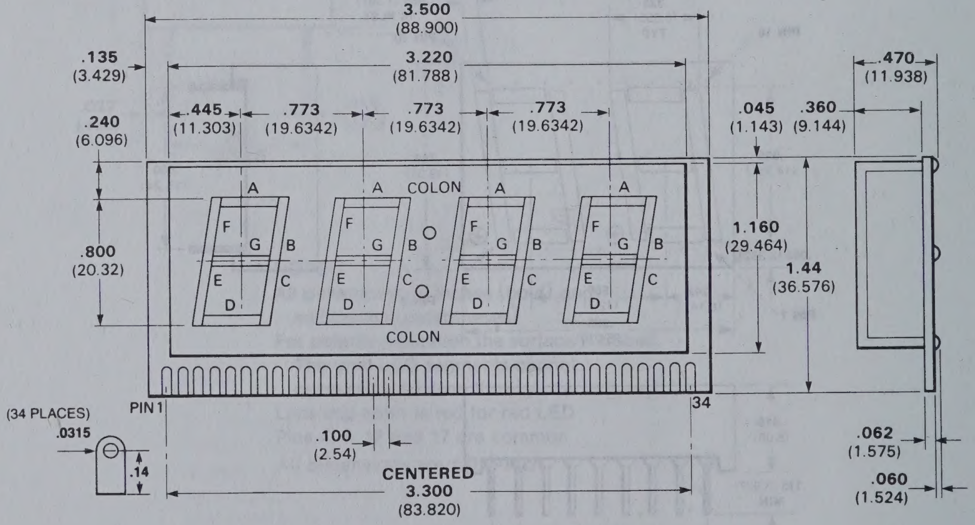
NOTES:
All dimensions in inches (bold) and millimeters (parentheses)

FAIRCHILD PACKAGE OUTLINES

Opto - 17

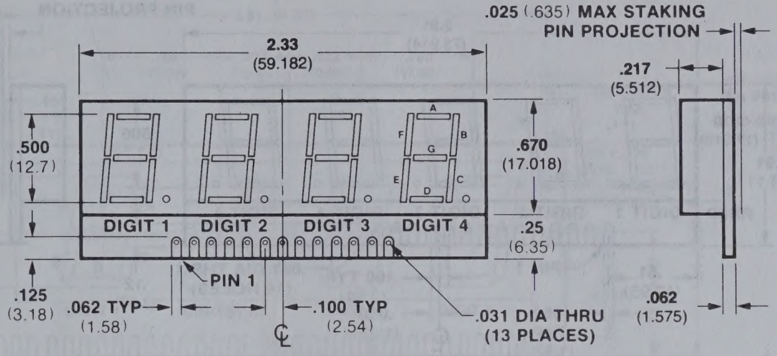

3.500
(88.900)
.135
(3.429)
3.220
(81.788)
.470
(11.938)
.240
(6.096)
.445
(11.303)
.773
(19.6342)
.773
(19.6342)
.773
(19.6342)
.045
(1.143)
.360
(9.144)
A
COLON
A
A
AM
PM
B
C
F
G
B
E
C
D
F
G
B
E
C
D
F
G
B
E
C
D
COLON
.800
(20.32)
1.160
(29.464)
1.44
(36.576)
(34 PLACES)
.0315
.14
PIN 1
34
.100
(2.54)
CENTERED
3.300
(83.820)
.062
(1.575)
.060
(1.524)

Opto - 18

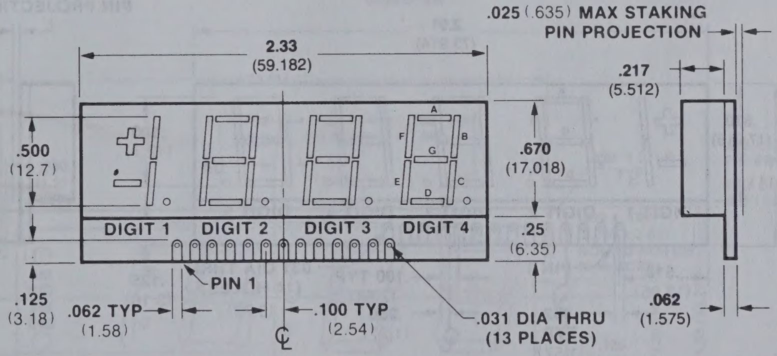

3.500
(88.900)
.135
(3.429)
3.220
(81.788)
.470
(11.938)
.240
(6.096)
.445
(11.303)
.773
(19.6342)
.773
(19.6342)
.773
(19.6342)
.045
(1.143)
.360
(9.144)
A
A
COLON
A
A
F
G
B
E
C
D
F
G
B
E
C
D
F
G
B
E
C
D
F
G
B
E
C
D
COLON
.800
(20.32)
1.160
(29.464)
1.44
(36.576)
(34 PLACES)
.0315
.14
PIN 1
34
.100
(2.54)
CENTERED
3.300
(83.820)
.062
(1.575)
.060
(1.524)

NOTES:
All dimensions in inches (bold) and millimeters (parentheses)

Opto - 20

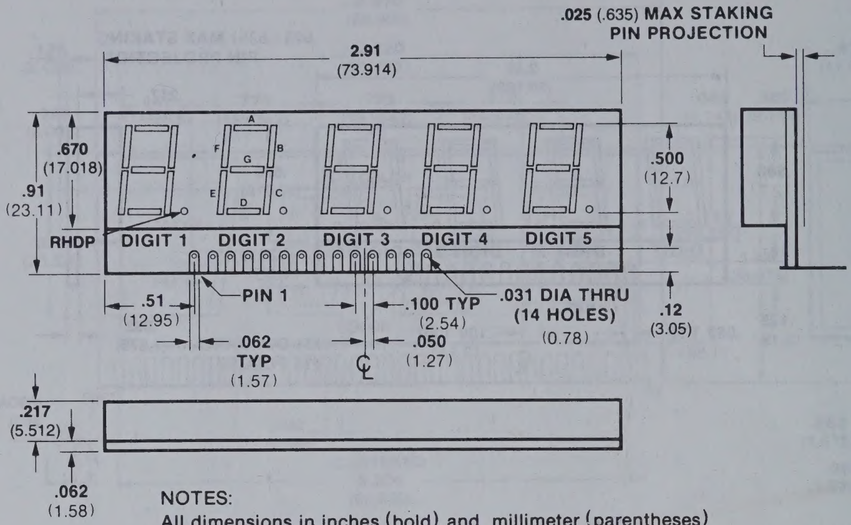

.025 (.635) MAX STAKING PIN PROJECTION
2.33
(59.182)
.217
(5.512)
A
F
B
G
E
C
D
.500
(12.7)
.670
(17.018)
DIGIT 1
DIGIT 2
DIGIT 3
DIGIT 4
.25
(6.35)
PIN 1
.125
(3.18)
.062 TYP
(1.58)
.100 TYP
(2.54)
℄
.031 DIA THRU
(13 PLACES)
.062
(1.575)

Opto - 21


.025 (.635) MAX STAKING PIN PROJECTION
2.33
(59.182)
.217
(5.512)
A
F
B
G
E
C
D
.500
(12.7)
.670
(17.018)
DIGIT 1
DIGIT 2
DIGIT 3
DIGIT 4
.25
(6.35)
PIN 1
.125
(3.18)
.062 TYP
(1.58)
.100 TYP
(2.54)
℄
.031 DIA THRU
(13 PLACES)
.062
(1.575)

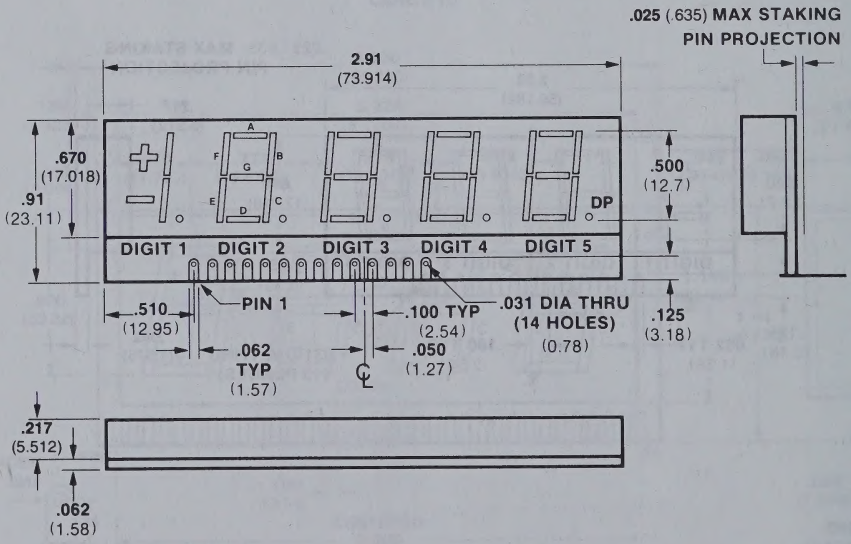
NOTES:
All dimensions in inches (bold) and millimeters (parentheses)

Opto - 22


.025 (.635) MAX STAKING
PIN PROJECTION
2.91
(73.914)
.670
(17.018)
.91
(23.11)
RHDP
A
F
B
G
E
C
D
DIGIT 1
DIGIT 2
DIGIT 3
DIGIT 4
DIGIT 5
.500
(12.7)
PIN 1
.031 DIA THRU
(14 HOLES)
(0.78)
.12
(3.05)
.51
(12.95)
.100 TYP
(2.54)
.062
TYP
(1.57)
.050
(1.27)
℄
.217
(5.512)
.062
(1.58)

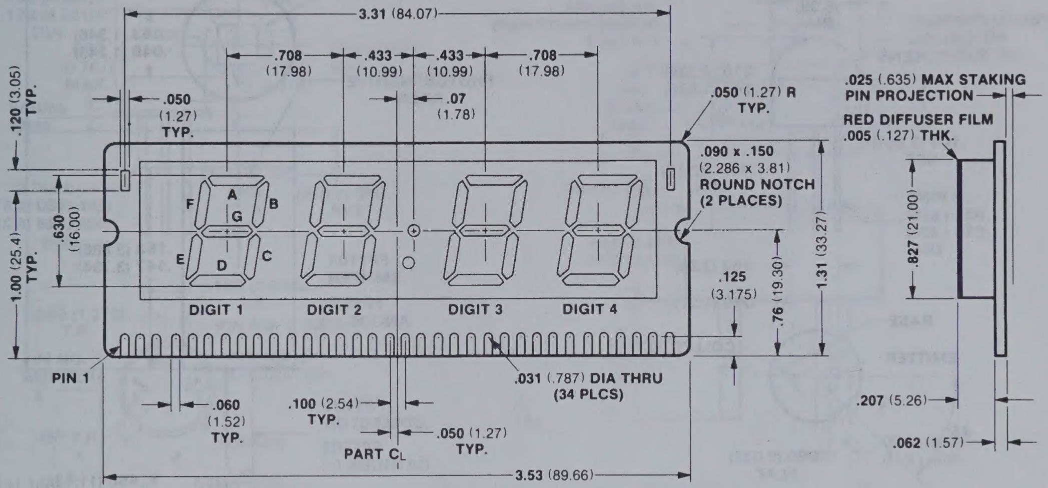
NOTES:
All dimensions in inches (bold) and millimeter (parentheses)
Tolerance unless specified:
.xx = ±.010 (0.25) .xxx = ±.005 (0.125)

Opto - 23


.025 (.635) MAX STAKING
PIN PROJECTION
2.91
(73.914)
.670
(17.018)
.91
(23.11)
A
F
B
G
E
C
D
DP
DIGIT 1
DIGIT 2
DIGIT 3
DIGIT 4
DIGIT 5
.500
(12.7)
PIN 1
.031 DIA THRU
(14 HOLES)
(0.78)
.125
(3.18)
.510
(12.95)
.100 TYP
(2.54)
.062
TYP
(1.57)
.050
(1.27)
℄
.217
(5.512)
.062
(1.58)

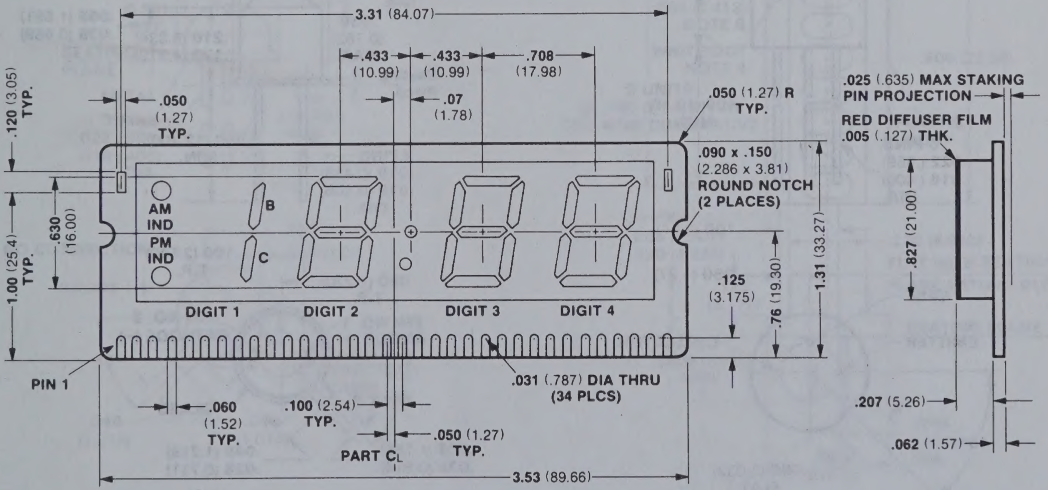
NOTES:
All dimensions in inches (bold) and millimeters (parentheses)

Opto-24


3.31 (84.07)
.708 (17.98)
.433 (10.99)
.433 (10.99)
.708 (17.98)
.120 (3.05) TYP.
.050 (1.27) TYP.
.07 (1.78)
.050 (1.27) R TYP.
.025 (.635) MAX STAKING PIN PROJECTION
RED DIFFUSER FILM .005 (.127) THK.
.090 x .150 (2.286 x 3.81) ROUND NOTCH (2 PLACES)
A
B
C
D
E
F
G
.630 (16.00)
1.00 (25.4) TYP.
.125 (3.175)
.76 (19.30)
1.31 (33.27)
.827 (21.00)
DIGIT 1
DIGIT 2
DIGIT 3
DIGIT 4
PIN 1
.031 (.787) DIA THRU (34 PLCS)
.060 (1.52) TYP.
.100 (2.54) TYP.
.050 (1.27) TYP.
PART C_L
.207 (5.26)
.062 (1.57)
3.53 (89.66)

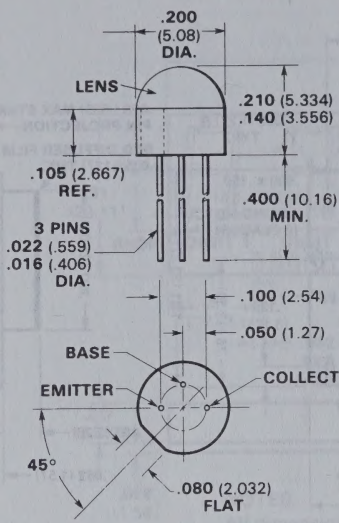
NOTE:
All dimensions in inches (bold) and millimeters (parentheses)
Colon cathodes tied to digits 3 & 4

Opto-25

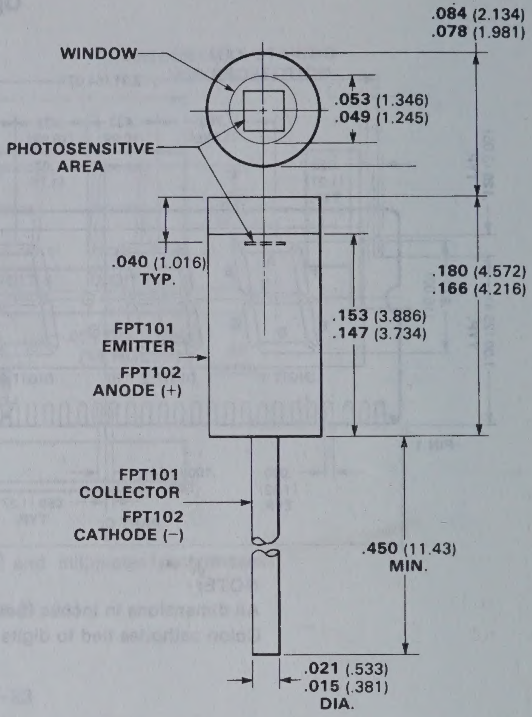

3.31 (84.07)
.433 (10.99)
.433 (10.99)
.708 (17.98)
.120 (3.05) TYP.
.050 (1.27) TYP.
.07 (1.78)
.050 (1.27) R TYP.
.025 (.635) MAX STAKING PIN PROJECTION
RED DIFFUSER FILM .005 (.127) THK.
.090 x .150 (2.286 x 3.81) ROUND NOTCH (2 PLACES)
AM IND
PM IND
B
C
.630 (16.00)
1.00 (25.4) TYP.
.125 (3.175)
.76 (19.30)
1.31 (33.27)
.827 (21.00)
DIGIT 1
DIGIT 2
DIGIT 3
DIGIT 4
PIN 1
.031 (.787) DIA THRU (34 PLCS)
.060 (1.52) TYP.
.100 (2.54) TYP.
.050 (1.27) TYP.
PART C_L
.207 (5.26)
.062 (1.57)
3.53 (89.66)

NOTE:
All dimensions in inches (bold) and millimeters (parentheses)
AM/PM Ind. cathodes tied to digits 1 & 2.
Colon cathodes tied to digits 3 & 4.

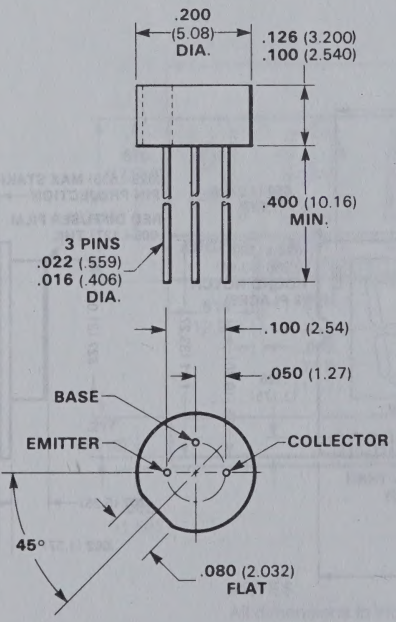
Opto - 26


.200
(5.08)
DIA.
LENS
.210 (5.334)
.140 (3.556)
.105 (2.667)
REF.
.400 (10.16)
MIN.
3 PINS
.022 (.559)
.016 (.406)
DIA.
.100 (2.54)
.050 (1.27)
BASE
EMITTER
COLLECTOR
45°
.080 (2.032)
FLAT

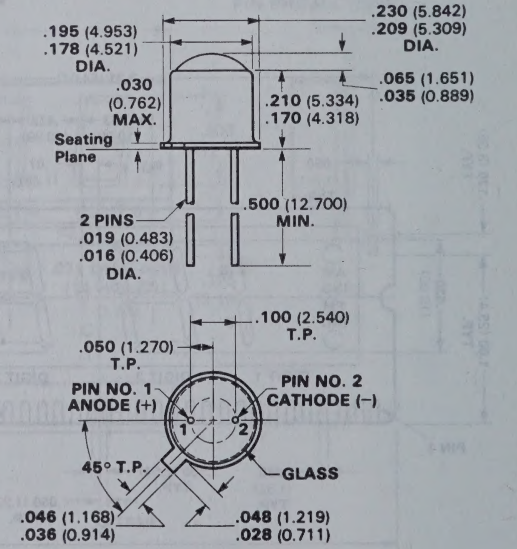
Opto - 27


.084 (2.134)
.078 (1.981)
WINDOW
.053 (1.346)
.049 (1.245)
PHOTOSENSITIVE
AREA
.040 (1.016)
TYP.
.180 (4.572)
.166 (4.216)
.153 (3.886)
.147 (3.734)
FPT101
EMITTER
FPT102
ANODE (+)
FPT101
COLLECTOR
FPT102
CATHODE (−)
.450 (11.43)
MIN.
.021 (.533)
.015 (.381)
DIA.

Opto - 28


.200
(5.08)
DIA.
.126 (3.200)
.100 (2.540)
.400 (10.16)
MIN.
3 PINS
.022 (.559)
.016 (.406)
DIA.
.100 (2.54)
.050 (1.27)
BASE
EMITTER
COLLECTOR
45°
.080 (2.032)
FLAT

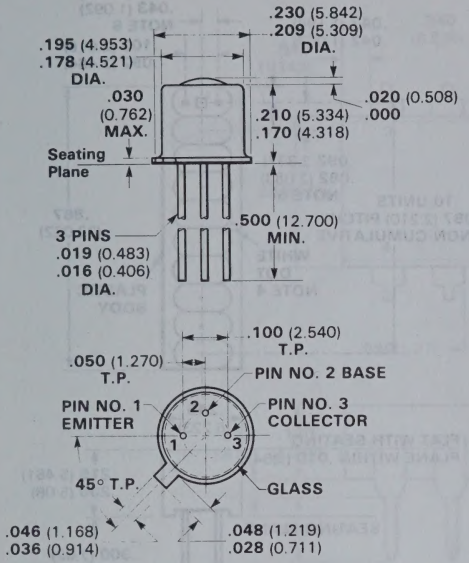
Opto - 29


.230 (5.842)
.209 (5.309)
DIA.
.195 (4.953)
.178 (4.521)
DIA.
.065 (1.651)
.035 (0.889)
.030
(0.762)
MAX.
.210 (5.334)
.170 (4.318)
Seating
Plane
.500 (12.700)
MIN.
2 PINS
.019 (0.483)
.016 (0.406)
DIA.
.100 (2.540)
T.P.
.050 (1.270)
T.P.
PIN NO. 1
ANODE (+)
PIN NO. 2
CATHODE (−)
1
2
45° T.P.
GLASS
.046 (1.168)
.036 (0.914)
.048 (1.219)
.028 (0.711)

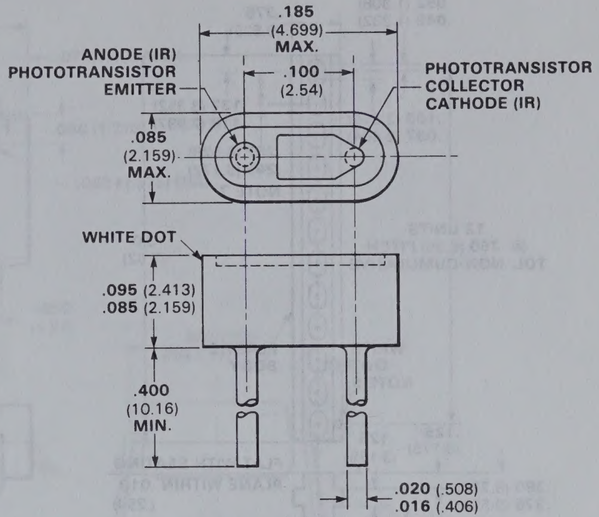
NOTES:
All dimensions in inches (bold) and millimeters (parentheses)

FAIRCHILD PACKAGE OUTLINES

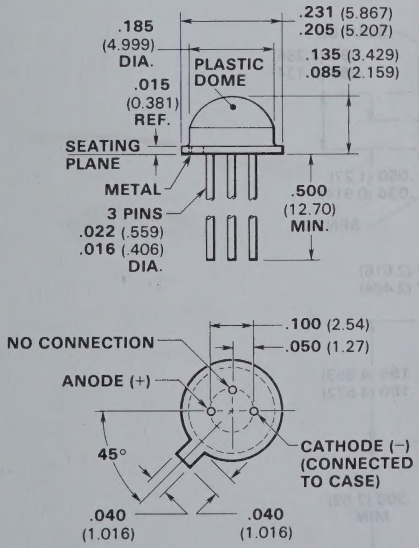
Opto - 30


.230 (5.842)
.209 (5.309)
DIA.
.195 (4.953)
.178 (4.521)
DIA.
.030
(0.762)
MAX.
.210 (5.334)
.170 (4.318)
.020 (0.508)
.000
Seating
Plane
.500 (12.700)
MIN.
3 PINS
.019 (0.483)
.016 (0.406)
DIA.
.100 (2.540)
T.P.
.050 (1.270)
T.P.
PIN NO. 2 BASE
PIN NO. 1
EMITTER
PIN NO. 3
COLLECTOR
2
1
3
45° T.P.
GLASS
.046 (1.168)
.036 (0.914)
.048 (1.219)
.028 (0.711)

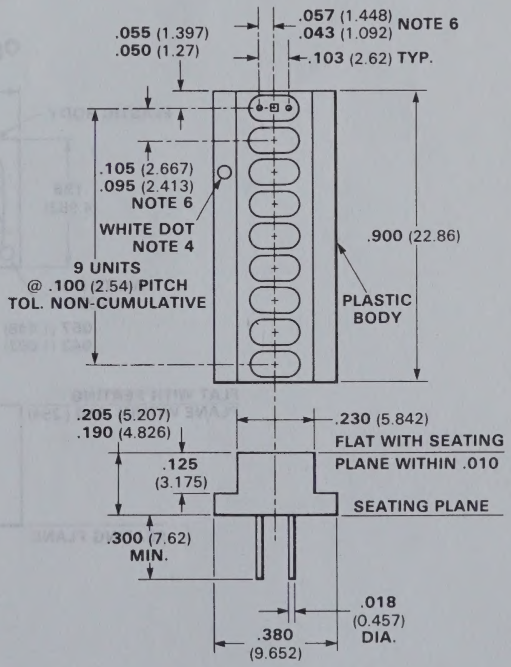
Opto - 31


.185
(4.699)
MAX.
ANODE (IR)
PHOTOTRANSISTOR
EMITTER
.100
(2.54)
PHOTOTRANSISTOR
COLLECTOR
CATHODE (IR)
.085
(2.159)
MAX.
WHITE DOT
.095 (2.413)
.085 (2.159)
.400
(10.16)
MIN.
.020 (.508)
.016 (.406)

Opto - 32


.185
(4.999)
DIA.
.231 (5.867)
.205 (5.207)
.135 (3.429)
.085 (2.159)
PLASTIC
DOME
.015
(0.381)
REF.
SEATING
PLANE
METAL
3 PINS
.022 (.559)
.016 (.406)
DIA.
.500
(12.70)
MIN.
NO CONNECTION
ANODE (+)
.100 (2.54)
.050 (1.27)
45°
CATHODE (−)
(CONNECTED
TO CASE)
.040
(1.016)
.040
(1.016)

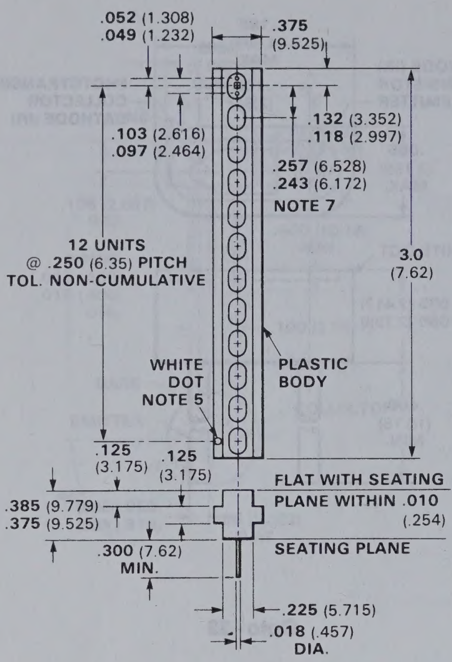
Opto - 33


.057 (1.448)
.043 (1.092)
NOTE 6
.055 (1.397)
.050 (1.27)
.103 (2.62) TYP.
.105 (2.667)
.095 (2.413)
NOTE 6
WHITE DOT
NOTE 4
9 UNITS
@ .100 (2.54) PITCH
TOL. NON-CUMULATIVE
.900 (22.86)
PLASTIC
BODY
.205 (5.207)
.190 (4.826)
.230 (5.842)
FLAT WITH SEATING
PLANE WITHIN .010
.125
(3.175)
SEATING PLANE
.300 (7.62)
MIN.
.018
(0.457)
DIA.
.380
(9.652)

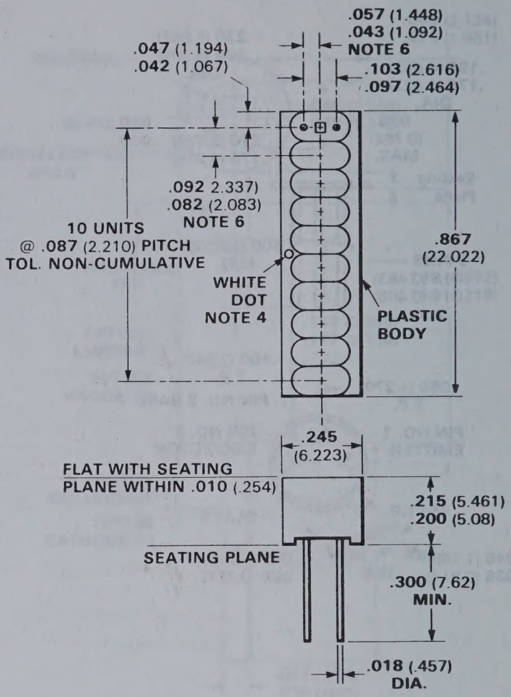
NOTES:
All dimensions in inches (bold) and millimeters (parentheses)

FAIRCHILD PACKAGE OUTLINES

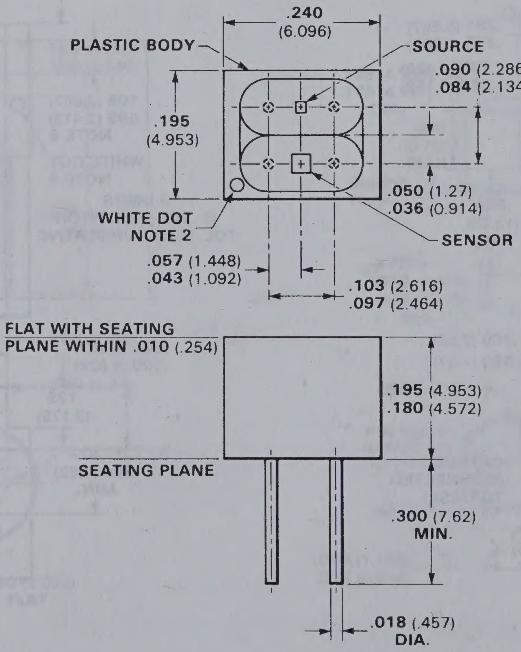
Opto - 34


.052 (1.308)
.049 (1.232)
.375
(9.525)
.103 (2.616)
.097 (2.464)
.132 (3.352)
.118 (2.997)
.257 (6.528)
.243 (6.172)
NOTE 7
12 UNITS
@ .250 (6.35) PITCH
TOL. NON-CUMULATIVE
3.0
(7.62)
WHITE
DOT
NOTE 5
PLASTIC
BODY
.125
(3.175)
.125
(3.175)
FLAT WITH SEATING
PLANE WITHIN .010
(.254)
.385 (9.779)
.375 (9.525)
SEATING PLANE
.300 (7.62)
MIN.
.225 (5.715)
.018 (.457)
DIA.

Opto - 35

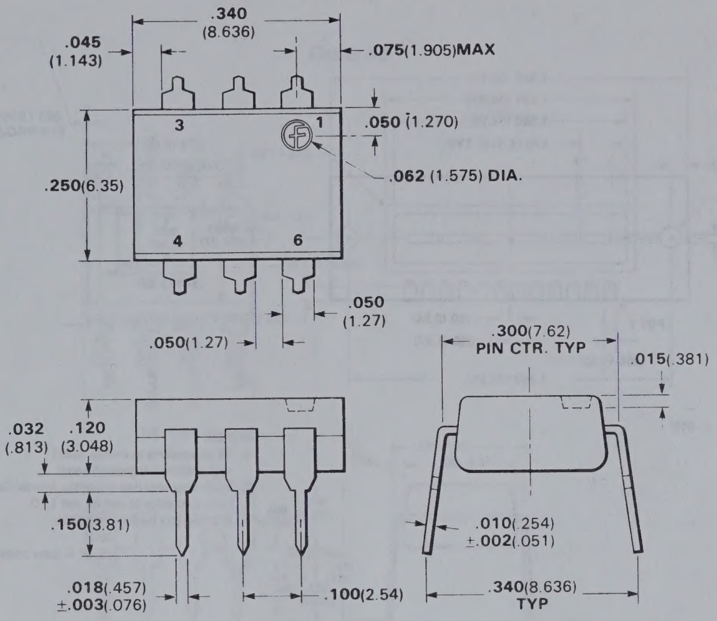

.057 (1.448)
.043 (1.092)
NOTE 6
.047 (1.194)
.042 (1.067)
.103 (2.616)
.097 (2.464)
.092 2.337)
.082 (2.083)
NOTE 6
10 UNITS
@ .087 (2.210) PITCH
TOL. NON-CUMULATIVE
.867
(22.022)
WHITE
DOT
NOTE 4
PLASTIC
BODY
.245
(6.223)
FLAT WITH SEATING
PLANE WITHIN .010 (.254)
.215 (5.461)
.200 (5.08)
SEATING PLANE
.300 (7.62)
MIN.
.018 (.457)
DIA.

Opto - 36


.240
(6.096)
PLASTIC BODY
SOURCE
.090 (2.286)
.084 (2.134)
.195
(4.953)
.050 (1.27)
.036 (0.914)
WHITE DOT
NOTE 2
SENSOR
.057 (1.448)
.043 (1.092)
.103 (2.616)
.097 (2.464)
FLAT WITH SEATING
PLANE WITHIN .010 (.254)
.195 (4.953)
.180 (4.572)
SEATING PLANE
.300 (7.62)
MIN.
.018 (.457)
DIA.

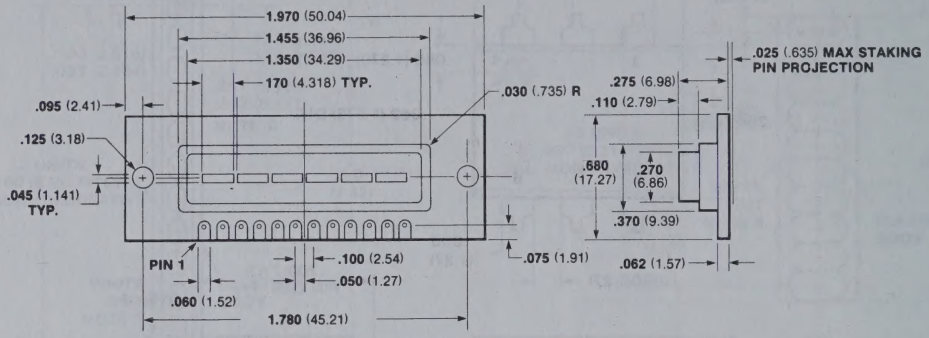
NOTES:
All dimensions in inches (bold) and millimeters (parentheses)

Opto - 37


.340
(8.636)
.045
(1.143)
.075(1.905)MAX
3
1
.050 (1.270)
.062 (1.575) DIA.
.250(6.35)
4
6
.050
(1.27)
.050(1.27)
.300(7.62)
PIN CTR. TYP
.015(.381)
.032
(.813)
.120
(3.048)
.150(3.81)
.010(.254)
±.002(.051)
.018(.457)
±.003(.076)
.100(2.54)
.340(8.636)
TYP

NOTES:
All dimensions in inches (bold) and millimeters (parentheses)

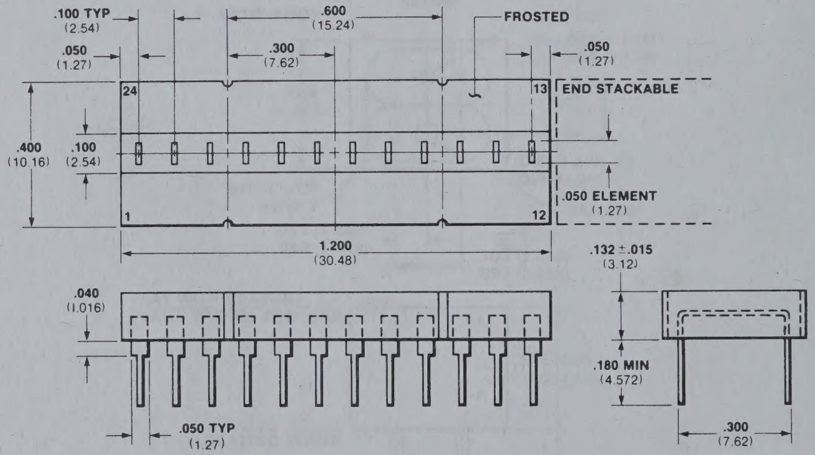
Opto 43


1.970 (50.04)
1.455 (36.96)
1.350 (34.29)
170 (4.318) TYP.
.030 (.735) R
.095 (2.41)
.125 (3.18)
.045 (1.141) TYP.
PIN 1
.100 (2.54)
.050 (1.27)
.060 (1.52)
1.780 (45.21)
.075 (1.91)
.025 (.635) MAX STAKING PIN PROJECTION
.275 (6.98)
.110 (2.79)
.680 (17.27)
.270 (6.86)
.370 (9.39)
.062 (1.57)

TOLERANCE ± .015

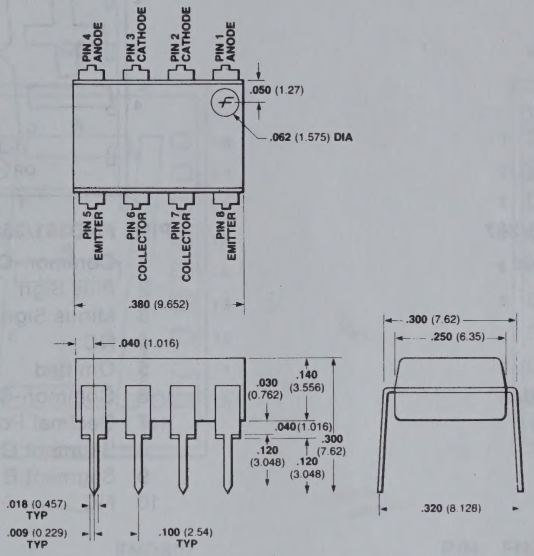
NOTES:
1. All dimensions in inches (bold) and millimeters (parentheses)
2. Each segment has separate Anode/Cathode
3. Lens cap color is red for red LED.
4. Marking (on back): FNA0006
   XXX
   (XXX = date code)

Opto 44


.100 TYP (2.54)
.600 (15.24)
FROSTED
.050 (1.27)
.300 (7.62)
.050 (1.27)
24
13
END STACKABLE
.400 (10.16)
.100 (2.54)
.050 ELEMENT (1.27)
1
12
1.200 (30.48)
.132 ± .015 (3.12)
.040 (1.016)
.180 MIN (4.572)
.050 TYP (1.27)
.300 (7.62)

NOTE:
All dimensions in inches (bold) and millimeters (parentheses)
Tolerance ±.015

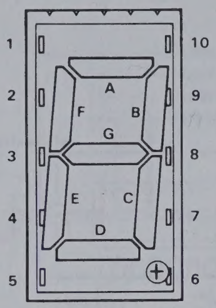
Opto 45


PIN 4 ANODE
PIN 3 CATHODE
PIN 2 CATHODE
PIN 1 ANODE
.050 (1.27)
.062 (1.575) DIA
PIN 5 EMITTER
PIN 6 COLLECTOR
PIN 7 COLLECTOR
PIN 8 EMITTER
.380 (9.652)
.040 (1.016)
.030 (0.762)
.140 (3.556)
.040 (1.016)
.300 (7.62)
.120 (3.048)
.120 (3.048)
.018 (0.457) TYP
.009 (0.229) TYP
.100 (2.54) TYP
.300 (7.62)
.250 (6.35)
.320 (8.128)

NOTES:
All dimensions in inches (bold) and millimeters (parentheses)
Package weight is 0.4 gram

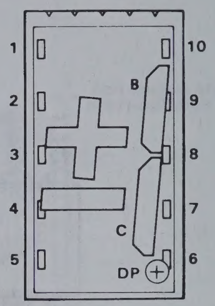
OPTOELECTRONICS

O1



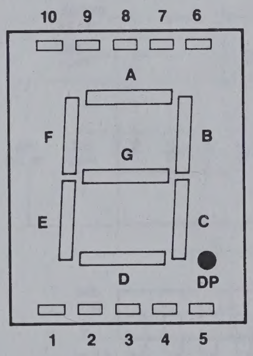
PIN	FND350/357/360/367
1	Common-Cathode
2	Segment F
3	Segment G
4	Segment E
5	Segment D
6	Common-Cathode
7	Decimal Point
8	Segment C
9	Segment B
10	Segment A

O2



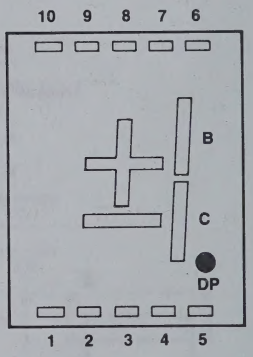
PIN	FND351/358/361/368
1	Common-Cathode
2	Plus Sign
3	Minus Sign
4	NC
5	Omitted
6	Common-Cathode
7	Decimal Point
8	Segment C
9	Segment B
10	NC

O3



PIN	FND507/537 547/557/567	FND500/530 540/550/560
1	Segment E	Segment E
2	Segment D	Segment D
3	Comm-Anode	Comm-Cathode
4	Segment C	Segment C
5	Decimal Point	Decimal Point
6	Segment B	Segment B
7	Segment A	Segment A
8	Comm-Anode	Comm-Cathode
9	Segment F	Segment F
10	Segment G	Segment G

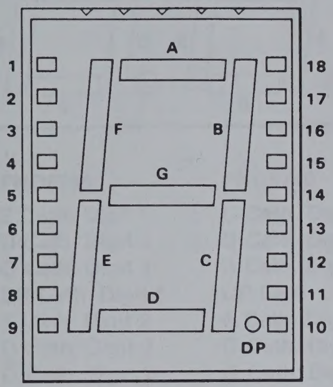
O4



PIN	FND501/531 541/551/561	FND508/538 548/558/568
1	Minus	Minus
2	Cathode ±	Anode ±
3	Segment C	Segment C
4	Cathode 1/DP	Anode 1/DP
5	Decimal Point	Decimal Point
6	Segment B	Segment B
7	Cathode 1/DP	Anode 1/DP
8	Cathode ±	Anode ±
9	Plus	Plus
10	NC	NC

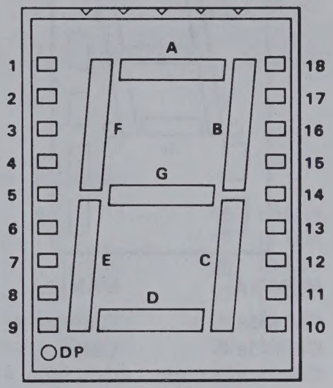
OPTOELECTRONICS

O5



PIN	FND800	FND807
1	Omitted	Omitted
2	Segment A	Segment A
3	Segment F	Segment F
4	Common-Cath.	Common-Anode
5	Segment E	Segment E
6	Common-Cath.	Common-Anode
7	NC	NC
8	Omitted	Omitted
9	Omitted	Omitted
10	Decimal Point	Decimal Point
11	Segment D	Segment D
12	Common-Cath.	Common-Anode
13	Segment C	Segment C
14	Segment G	Segment G
15	Segment B	Segment B
16	Omitted	Omitted
17	Common-Cath.	Common-Anode
18	Omitted	Omitted

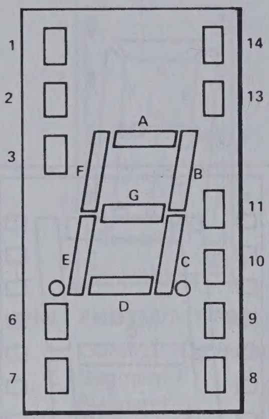
O6



PIN	FND850	FND847
1	Omitted	Omitted
2	Segment A	Segment A
3	Segment F	Segment F
4	Common-Cath.	Common-Anode
5	Segment E	Segment E
6	Common-Cath.	Common-Anode
7	DP	DP
8	Omitted	Omitted
9	Omitted	Omitted
10	NC	NC
11	Segment D	Segment D
12	Common-Cath.	Common-Anode
13	Segment C	Segment C
14	Segment G	Segment G
15	Segment B	Segment B
16	Omitted	Omitted
17	Common-Cath.	Common-Anode
18	Omitted	Omitted

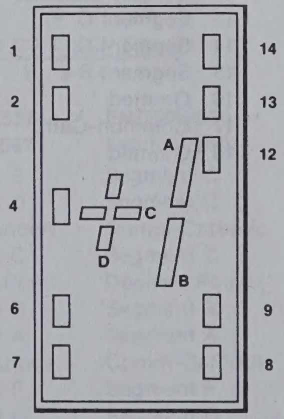
OPTOELECTRONICS

O7



PIN	MAN71A	MAN72A
1	Cathode A	Cathode A
2	Cathode F	Cathode F
3	Common-Anode	Common-Anode
4	No pin	No pin
5	No pin	No pin
6	NC	Cathode DP
7	Cathode E	Cathode E
8	Cathode D	Cathode D
9	Common-Anode	NC
10	Cathode C	Cathode C
11	Cathode G	Cathode G
12	No pin	No pin
13	Cathode B	Cathode B
14	Common-Anode	Common-Anode

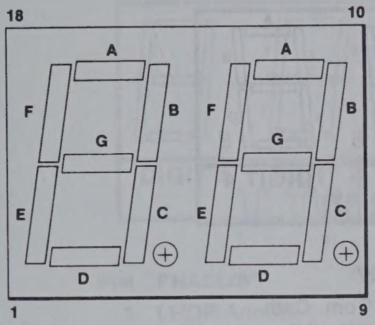
O9



PIN	MAN74A
1	Anode F
2	Anode G
3	No pin
4	Common-Cathode
5	No pin
6	Anode E
7	Anode D
8	Anode C
9	Anode DP
10	No pin
11	No pin
12	Common-Cathode
13	Anode B
14	Anode A

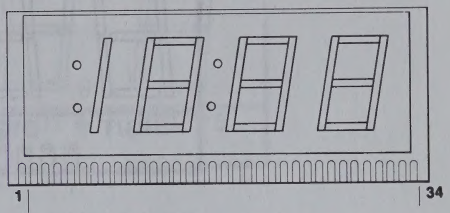
OPTOELECTRONICS

O10



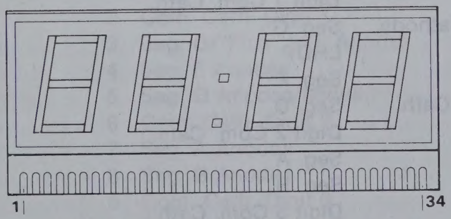
PIN	FND6710	FND6740
1	E Cath. Digit 1	C Cath. Digit 1
2	D Cath. Digit 1	D Cath. Digit 1
3	C Cath. Digit 1	B Cath. Digit 1
4	DP Cath. Digit 1	DP Cath. Digit 1
5	E Cath. Digit 2	E Cath. Digit 2
6	D Cath. Digit 2	D Cath. Digit 2
7	G Cath. Digit 2	G Cath. Digit 2
8	C Cath. Digit 2	C Cath. Digit 2
9	DP Cath. Digit 2	DP Cath. Digit 2
10	B Cath. Digit 2	B Cath. Digit 2
11	A Cath. Digit 2	A Cath. Digit 2
12	F Cath. Digit 2	F Cath. Digit 2
13	Digit 2 Anode	Digit 2 Anode
14	Digit 1 Anode	Digit 1 Anode
15	B Cath. Digit 1	A Cath. Digit 1
16	A Cath. Digit 1	NC
17	G Cath. Digit 1	NC
18	F Cath. Digit 1	NC

O11



PIN	FCS8000
1	NC
2	NC
3	Indicator
4	NC
5	Indicator
6	10 Hrs. C
7	10 Hrs. B
8	NC
9	Hrs. F
10	Hrs. G
11	Hrs. E
12	Hrs. A
13	Hrs. B
14	Hrs. D
15	Hrs. C
16	Colons
17	NC
18	10 Min. F
19	10 Min. E
20	10 Min. G
21	10 Min. A
22	10 Min. D
23	10 Min. B
24	10 Min. C
25	NC
26	Min. F
27	Min. E
28	Min. G
29	Min. A
30	Min. B
31	Min. C
32	Min. D
33	NC
34	V_{LED}

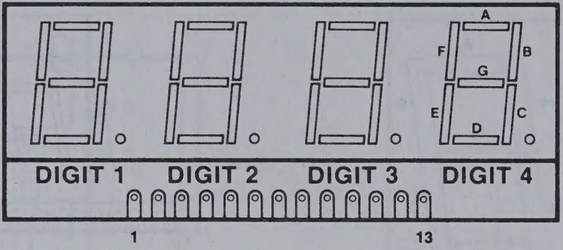
O12



PIN	FCS8024
1	10 Hrs. A
2	10 Hrs. E
3	10 Hrs. D
4	10 Hrs. G
5	10 Hrs. F
6	10 Hrs. C
7	10 Hrs. B
8	NC
9	Hrs. F
10	Hrs. G
11	Hrs. E
12	Hrs. A
13	Hrs. B
14	Hrs. D
15	Hrs. C
16	Colons
17	NC
18	10 Min. F
19	10 Min. E
20	10 Min. G
21	10 Min. A
22	10 Min. D
23	10 Min. B
24	10 Min. C
25	NC
26	Min. F
27	Min. E
28	Min. G
29	Min. A
30	Min. B
31	Min. C
32	Min. D
33	NC
34	V_{LED}

OPTOELECTRONICS

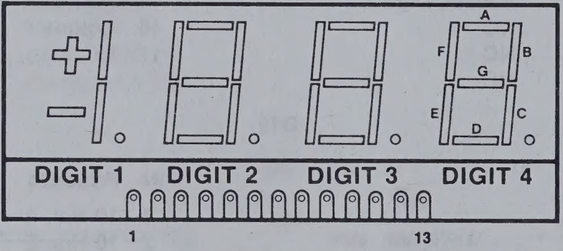
O13


A
F
B
G
E
C
D
DIGIT 1
DIGIT 2
DIGIT 3
DIGIT 4
1
13

PIN	FNA5420	FNA5427
1	Digit 1 Com. Anode	Digit 1 Com. Cath.
2	Seg. G	Seg. G "Plus" Sign Anode
3	NC	NC
4	Seg. F	Seg. F
5	Seg. D	Seg. D "Minus" Sign Anode
6	Digit 2 Com. Anode	Digit 2 Com. Cath.
7	Seg. A	Seg. A
8	Seg. B	Seg. B
9	Digit 3 Com. Anode	Digit 3 Com. Cath.
10	RNDP	RHDP
11	Seg. C	Seg. C
12	Seg. E	Seg. E
13	Digit 4 Com. Anode	Digit 4 Com. Cath.

Preliminary Pin Assignment

O14

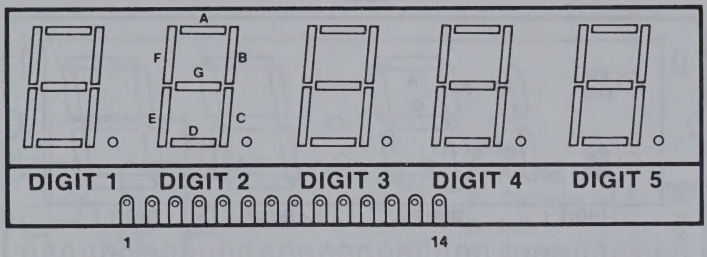

A
F
B
G
E
C
D
DIGIT 1
DIGIT 2
DIGIT 3
DIGIT 4
1
13

PIN	FNA5428	FNA5421
1	Digit 1 Com. Anode	Digit 1 Com. Cath.
2	Seg. G "Plus" Sign Cathode	Seg. G
3	NC	LHDP
4	Seg. F	Seg. F
5	Seg. D "Minus" Sign Cath.	Seg. D
6	Digit 2 Com. Anode	Digit 2 Com. Cath.
7	Seg. A	Seg. A
8	Seg. B	Seg. B
9	Digit 3 Com. Anode	Digit 3 Com. Cath.
10	RHDP	RHDP
11	Seg. C	Seg. C
12	Seg. E	Seg. E
13	Digit 4 Com. Anode	Digit 4 Com. Cath.

Preliminary Pin Assignment

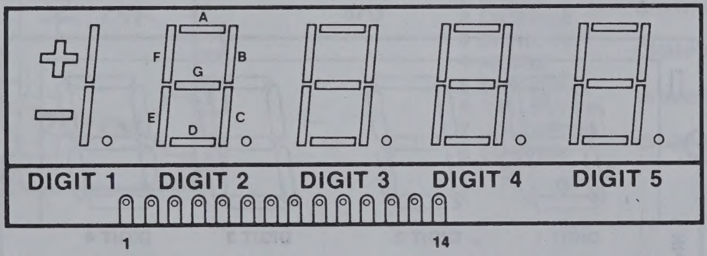
OPTOELECTRONICS

O15



PIN	FNA5520*	FNA5527*
1	LHDP Anodes	LHDP Cathodes
2	Digit 1 Com. Cathodes	Digit 1 Com. Anode
3	Seg. G, "Plus" Sign Anodes	Seg. G, "Plus Sign Cath.
4	Seg. F Anodes	Seg. F Cath.
5	Seg. D, "Minus" Sign Anodes	Seg. D, "Minus" Sign Cath.
6	Digit 2 com. Cathodes	Digit 2 Com. Anode
7	Seg. A Anodes	Seg. A Cath.
8	Seg. B Anodes	Seg. B Cath.
9	Digit 3 Com. Cathodes	Digit 3 Com. Anode
10	RHDP Anodes	RHDP Cath.
11	Seg. C Anodes	Seg. C Cath.
12	Seg. E Anodes	Seg. E Cath.
13	Digit 4 Com. Cathodes	Digit 4 Com. Anode
14	Digit 5 Com. Cathodes	Digit 5 Com. Anode

O16

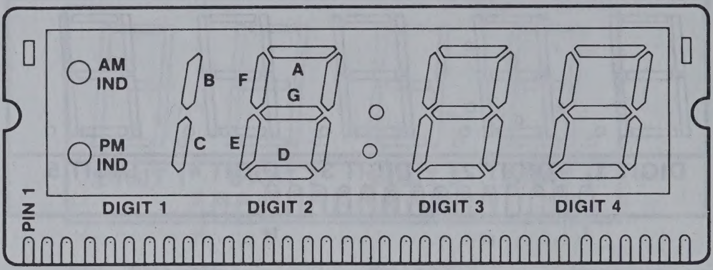


PIN	FNA5521	FNA5528*
1	NC	NC
2	Com. Cath. Digit 1	Com. Anode Digit 1
3	Seg. G/"Plus" Ind. Anodes	Seg. G, "Plus" Sign Cath.
4	Seg. F Anodes	Seg. F Cath.
5	Seg. D Anodes/Minus	Seg. D Cath.
6	Com. Cath. Digit 2	Digit 2 Com. Anode
7	Seg. A Anodes	Seg. A Cath.
8	Seg. B Anodes	Seg. B Cath.
9	Com. Cath. Digit 3	Digit 3 Com. Anode
10	DP Anodes	DP Cath.
11	Seg. C Anodes	Seg. C Cath.
12	Seg. E Anodes	Seg. E Cath.
13	Com. Cath. Digit 4	Digit 4 Com. Anode
14	Com. Cath. Digit 5	Digit 5 Com. Anode

***Preliminary Pin Assignment**

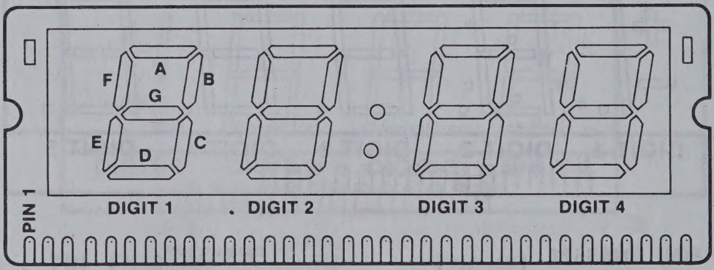
OPTOELECTRONICS

O17



PIN	FCS6400
1	Com. Cath. Digits 1 & 2
2	NC
3	N/C
4	Segment A1 Anode
5	Segment F1 Anode
6	Segment G1 Anode
7	Segment E1 Anode
8	Segment D1
9	Segment C1 Anode
10	Segment B1 Anode
11	Segment F2 Anode
12	Segment G2 Anode
13	Segment A2 Anode
14	Segment B2 Anode
15	Segment E2 Anode
16	Segment D2 Anode
17	Segment C2 Anode
18	Colon Anode
19	Colon Anode
20	Segment F3 Anode
21	Segment G3 Anode
22	Segment A3 Anode
23	Segment B3 Anode
24	Segment D3 Anode
25	Segment E3 Anode
26	Segment C3
27	Segment F4
28	Segment G4 Anode
29	Segment A4 Anode
30	Segment B4 Anode
31	Segment E4 Anode
32	Segment D4 Anode
33	Segment C4 Anode
34	Com. Cath. Digits 3 & 4

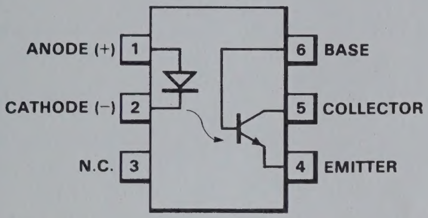
O18



PIN	FCS6401
1	Com. Cath. Digits 1 & 2
2	PM IND. Anode
3	AM IND.
4	N/C
5	N/C
6	N/C
7	N/C
8	N/C
9	Segment C1 Anode
10	Segment B1 Anode
11	Segment F2 Anode
12	Segment G2 Anode
13	Segment A2 Anode
14	Segment B2 Anode
15	Segment E2 Anode
16	Segment D2 Anode
17	Segment C2 Anode
18	Colon Anode
19	Colon Anode
20	Segment F3 Anode
21	Segment G3 Anode
22	Segment A3 Anode
23	Segment B3 Anode
24	Segment D3 Anode
25	Segment E3 Anode
26	Segment C3 Anode
27	Segment F4 Anode
28	Segment G4 Anode
29	Segment A4 Anode
30	Segment B4 Anode
31	Segment E4 Anode
32	Segment D4 Anode
33	Segment C4 Anode
34	Com. Cath. Digits 3 & 4

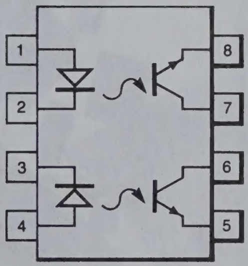
OPTOELECTRONICS

O24

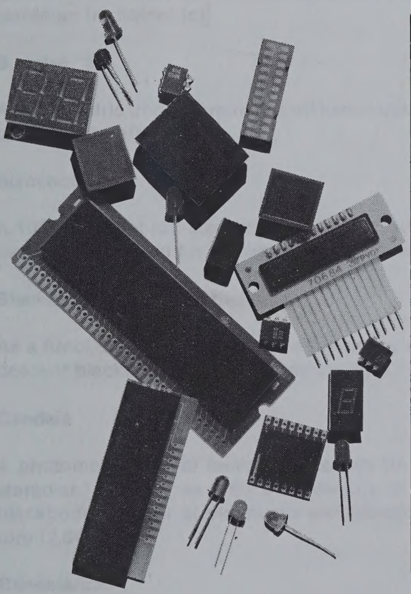

ANODE (+)
1
CATHODE (−)
2
N.C.
3
6
BASE
5
COLLECTOR
4
EMITTER

PIN		
1	Anode (+)	Input Diode
2	Cathode (-)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

025



PIN	
1 ANODE 2 CATHODE	CHANNEL #1
3 CATHODE 4 ANODE	CHANNEL #2
5 EMITTER 6 COLLECTOR	CHANNEL #1
7 COLLECTOR 8 EMITTER	CHANNEL #2



OPTOELECTRONIC TECHNOLOGY 1

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— OPTO —
DEFINITION OF SYMBOLS AND TERMS

Angstrom (Å)

A unit of length particularly for measuring electromagnetic wavelengths; one angstrom = 10^{-10} meters = 10^{-4} microns = 3.937 X 10^{-9} in.

Angular Alignment

A measure of the deviation of the optical axis from the mechanical axis.

Area Source

A source with a diameter greater than 10% of the distance between it and the detector.

Axial Intensity (I_O):

The ratio of the flux emitted by a source and contained within an incremental on axis solid angle subtended by a sensor [units: lumens/steradian (photometric) or watts/steradian (radiometric)]

B_L (also "B")

A photometric unit of luminance in (lumens/steradian)/ft^2 or foot-Lamberts.

Blackbody

A 100% efficient radiator and absorber of radiant energy used as a standard for all irradiance measurements.

Blackbody Luminous Efficiency

As a function of temperature, the efficiency of an incandescent blackbody in terms of visible light.

Candela

A photometric unit of luminous intensity (in lumens per steradian) defined as 1/60 the intensity of a one cm^2 blackbody radiator at platinum's solidification temperature (2,046° K).

Candela/cm^2

Luminance unit called "stilb".

$(1/\pi)$ candela/cm^2

Luminance unit called "Lambert".

Color Temperature

The temperature of a blackbody whose radiation has the same visible color as that of a given non-blackbody radiator. TYPICAL UNIT: K (formerly °K).

Conversion Efficiency (of a Photoemissive Device)

The ratio of maximum available luminous or radiant flux output to total input power.

Critical Angle

The maximum angle of incidence for which light will be transmitted from one medium to another. Light approaching the interface at angles greater than the critical angle will be reflected back into the first medium.

Dark Current (I_D)

The current which flows in a photodetector when there is no incident radiation on the detector.

D-C Transfer Ratio (of an Optically Coupled Isolator)

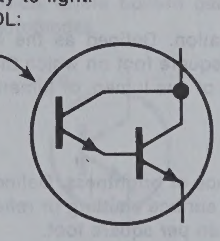
The ratio of the dc output current to the dc input current.

Darlington Amplifier

A composite configuration of transistors which provides a high input impedance and a high degree of amplification.

Darlington Connector Phototransistor

A phototransistor the collector and emitter of which are connected to the collector and base, respectively, of a second transistor. The emitter current of the input transistor is amplified by the second transistor and the device has very high sensitivity to light.
GRAPHIC SYMBOL:

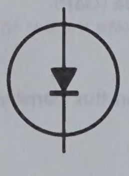


Delay Time (t_d)

The time interval from the point at which the leading edge of the input pulse has reached 10% of its maximum amplitude to the point at which the leading edge of the output pulse has reached 10% of its maximum amplitude.

Diode

A semiconductor device which passes current in only one direction.



DEFINITION OF SYMBOLS AND TERMS CON'T.

Duty Cycle

A measure of the effect of a pulsed input to a lamp. Expressed as a percentage of on time as compared to total time.

E

Photometric unit of illuminance in lumens/ft^2 (footcandle)

Emission Beam Angle Between Half-Power Points (θ_{HP})

The angle centered on the optical axis of a light-emitting diode within which the relative radiant power output or photon intensity is not less than half of the maximum output or intensity.

Fall Time (t_f)

The time duration during which the trailing edge of a pulse is decreasing from 90% to 10% of its maximum amplitude.

Flux

Power passing through a surface (energy per unit time); number of photons passing through a surface per unit time. Expressed in lumens or watts.

Flux Density

A measure of the strength of a wave; flux per unit area normal to the direction of the flux; number of photons passing through a surface per unit time per unit area. Expressed in watts/cm^2 or lumens/ft^2.

Foot-candle

Unit of illumination. Defined as the illuminance on a surface of one square foot on which there is a uniformly distributed flux of one lumen, or lumens/ft^2.

Foot-lambert

Unit of luminance or brightness. Defined as the uniform luminance of a surface emitting or reflecting light at the rate of one lumen per square foot.

Forward Voltage (V_F)

The voltage across a semiconductor diode associated with the flow of forward current. The p-region is at a positive potential with respect to the n-region.

GaAs, GaAsP, GaP

The most commonly used emitter materials are gallium arsenide (GaAs), gallium arsenide phosphide (GaAsP) and gallium phosphide (GaP).

H

Irradiance or radiation flux density in watts/cm^2 (radiometric unit).

Half intensity beam angle (O_{HI})

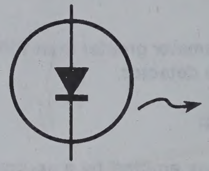
The angle within which the radiant intensity is not less than half the maximum.

Illumination (E_V)

The luminous flux density incident on a surface; the ratio of flux to area of illuminated surface.
TYPICAL UNITS: lm/ft^2, lx = lm/m^2 .1 lm/ft^2 = 10.764 lx.

Infrared Light-Emitting Diode (Infrared Emitter)

An optoelectronic device containing a semiconductor p-n junction which emits radiant energy in the 0.78-μm to 100-μm wavelength region when forward-biased.



Irradiance (H or E_e)

The radiant flux density incident on a surface; the ratio of flux to area of irradiated surface.
TYPICAL UNITS: W/ft^2, W/m^2. 1 W/ft^2 = 10.764 W/m^2.

Light

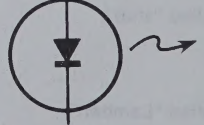
For the purpose of these definitions, radiant energy transmitted by wave motion with wavelengths from about 0.3 μm to 30 μm; this includes visible wavelengths (0.38 μm to 0.78 μm) and those wavelengths, such as ultraviolet and infrared, which can be handled by optical techniques used for the visible region. In more restricted usage, radiant energy within the limits of the visual spectrum.

Light Current (I_L)

The current that flows through a photosensitive device, such as a phototransistor or a photodiode, when it is exposed to illumination or irradiance.

Light-Emitting Diode (LED)

Light-emitting diode that emits visible light.



Lumen

Unit of flux; flux through one steradian from a uniform point source of one candle.

DEFINITION OF SYMBOLS AND TERMS CON'T.

Luminescence

Emission of light due to any other cause than high temperature (incandescence).

Luminance (L) (Photometric Brightness)

The luminous intensity of a surface in a given direction per unit of projected area of the surface as viewed from that direction.
TYPICAL UNITS: fL, cd/ft^2, cd/m^2. 1 fL = $(1/\pi)$ cd/ft^2 = 3.4263 cd/m^2.

Luminous Flux (Φ_V)

The time rate of flow of light.
TYPICAL UNIT: lm
NOTE: Luminous flux is related to radiant flux by the eye-response curve of the International Commission on Illumination (CIE). At the peak response ($\lambda = 555$ nm), 1 W = 680 lm.

Luminous Intensity (I_v)

Luminous flux per unit solid angle in a given direction.
TYPICAL UNIT: cd. 1 cd = 1 lm/sr

Off-State Collector Current (of an Optically Coupled Isolator) ($I_{C(off)}$)

The output current when the input current is zero.

On-State Collector Current (of an Optically Coupled Isolator) ($I_{C(on)}$)

The output current when the input current is above a threshold level. An increase in the input current will usually result in a corresponding increase in the on-state collector current.

Optical Axis

A line about which the radiant-energy pattern is centered; usually perpendicular to the active area.

Optically Coupled Isolator

An optoelectronic device consisting of a photoemissive device and a photodetector integrated into a single entity and intended for the transfer of a signal from the input to the output.

Photocurrent

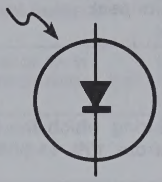
The difference between light current (I_L) and dark current (I_D) in a photodetector.

Photodetector

A device which senses incident radiation.

Photodiode

A solid state device, much like an ordinary diode except that incident light on the pn junction causes the device to conduct. It acts as an open circuit (ideally) in the dark. The photodiode is characterized by a linear relationship between input radiation and output current. It has faster switching speeds than a phototransistor.



Photometric Axis

The direction from the source of radiant energy in which the measurement of photometric parameters is performed

Photometric Brightness

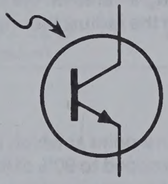
See Luminance.

Photon

A quantum (the smallest possible unit) of radiant energy; a photon carries q quantity of energy equal to Planck's constant times the frequency.

Phototransistor

Solid state device similar to an ordinary transistor except that light incident on the pn junctions controls the response of this device; offers built-in gain and greater sensitivity than photodiodes.



Point Source

Radiation source whose maximum dimension is less than 1/10 the distance between source and receiver.

Quantum Efficiency (of a Photosensitive Device)

The ratio of the number of carriers generated to the number of photons incident upon the active region.

Radiant Flux (Φ_e)

The time rate of flow of radiant energy.
TYPICAL UNIT: W

DEFINITION OF SYMBOLS AND TERMS CON'T.

Radiant Pulse Fall Time (t_f)

The time required for a photometric quantity to change from 90% to 10% of its peak value for a step change in electrical input.

Radiant Pulse Time (t_r)

The time required for a photometric quantity to change from 10% to 90% of its peak value for a step change in electrical input.

Rise Time (t_r)

The time duration during which the leading edge of a pulse is increasing from 10% to 90% of its maximum amplitude.

Spectral Output (of a Light-Emitting Diode)

A description of the radiant-energy or light-emission characteristic versus wavelength. This information is usually given by stating the wavelength at peak emission and the bandwidth between half-power points or by means of a curve.

Spectral Distribution of Energy (E_λ)

A plot showing the variation of spectral emission with wavelength.

Spectral Response (of a Photosensitive Device)

A curve of the electrical-output characteristic versus wavelength of radiant energy incident upon the device.

Steradian

Solid angle subtending an area on the surface of a sphere equal to the square of the radius; there are 4π steradians in a sphere.

Storage Time (t_s)

The time interval from a point at which the trailing edge of the input pulse has dropped to 90% of its maximum amplitude to a point at which the trailing edge of the output pulse has dropped to 90% of its maximum amplitude.

Threshold Voltage

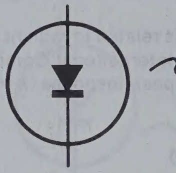
Voltage at which a pn junction begins to pass a current; in a solid state lamp, the voltage at which light is first emitted.

Visible Emission, Visible Light

Radiation which is characterized by wavelengths of about 0.38 μm to 0.78 μm.

Visible-Light-Emitting Diode (VLED)

An optoelectronic device containing a semiconductor junction which emits visible light when forward-biased.



Wavelength at Peak Emission (λ_p)

The wavelength at which the power output from a light-emitting diode is maximum
TYPICAL UNITS: Å, μm, nm. 1 Å = 10^{-4} μm = 0.1 nm.

Radiation and Illumination Sources

The effect of a radiation source on a photodevice is dependent on the device spectral response and the spectral distribution of energy from the source. To discuss such energy, two related sets of terminology are available. The first, radiometric, is a physical system, and the secone, photometric, is a physiological system, which defines energy relative to its visual effect.

The defining factor for the photometric system is the spectral response curve of a standard observer, whereas the defining spectral response of the radiometric system can be imagined as unit response for all wavelengths.

---

[2] **Steradian: The solid equivalent of a radian**

DEFINITION OF SYMBOLS AND TERMS CON'T.

CONVERSION TABLE

Symbol	Unit	Note
A	Ampere	
Å	Angstrom	1 Å = 10^{-10} m = 10^{-4} μm = 0.1 nm
cd	Candela	1 cd = 1 lm/sr
°C	Degree Celsius	
°K		See K
ft	Foot	
fc	Footcandle	The equivalent unit lm/ft² is preferred
fL	Footlambert	1 fL = $(1/\pi)$ cd/ft² = 3.4263 cd/m²
Hz	Hertz	
in	Inch	
K-	Kelvin	Formerly °K, degree Kelvin
L	Lambert	
lm	Lumen	
lx	Lux	1 lx = 1 lm/m²
m	Meter	
μ	Micron	The equivalent unit μm is preferred
nt	Nit	1 nt = 1 cd/m²
Ω	Ohm	
s	Second	
sr	Steradian	
sb	Stilb	1 sb = 1 cd/cm²
V	Volt	
W	Watt	

UNITS OF MEASUREMENT

TO CONVERT FROM:	TO:	MULTIPLY BY:
Angstroms	Nanometers Millimicrons	0.1
Angstroms	Microns Micrometers	0.0001
Nanometers Millimicrons	Angstroms	10
Microns Micrometers	Angstroms	10,000
Nanometers Millimicrons	Microns Micrometers	.001
Microns Micrometers	Nanometers Millimicrons	1000

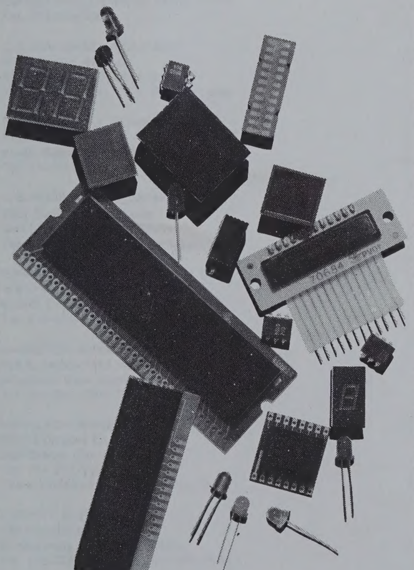
Description	Radiometric all wavelengths	Photometric visible light
Total Flux	Radiant Flux, P. In Watts	Luminous Flux, F, in Lumens
Emitted Flux Density at a Source Surface	Radiant Emittance, W, in Watts/cm²	Luminous Emittance, L, in Lumens/ft² (footlamberts), or lumens/cm² (Lamberts)
Source Intensity (Point Source)	Radiant Intensity, I_r, in Watts/Steradian	Luminous Intensity, I_L, in Lumens/Steradian (Candela)
Source Intensity (Area Source)	Radiance, B_r, in (Watts/Steradian) /cm²	Luminance, B_L, in (Lumens/Steradian) /ft² (footlambert)
Flux Density Incident on a Receiver Surface	Irradiance, H, in Watts/cm²	Illuminance, E, in Lumens/ft² (footcandle)

POINT SOURCE RELATIONSHIPS

Description	Radiometric	Photometric
Point Source Intensity	I_r, Watts/Steradian	I_L, Lumens/Steradian
Incident Flux Density	H (Irradiance) = I_r/r^2 watts/distance²	E (Illuminance) = I_L/r^2 lumens/distance²
Total Flux Output of Point Source	$P = 4\pi I_r$ Watts	$F = 4\pi I_L$ Lumens

DESIGN RELATIONSHIPS FOR AN AREA SOURCE

Description	Radiometric	Photometric
Source Intensity	B_r, Watts/cm²/steradian	B_L, Lumens/cm²/steradian
Emitted Flux Density	$W = \pi B_r$, Watts/cm²	$L = \pi B_L$, Lumens/cm²
Incident Flux Density	$H = \frac{B_r A_s}{r^2 + d/2^2}$, Watts/cm²	$E = \frac{B_L A_S}{r^2 + d/2^2}$, Lumens/cm²



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